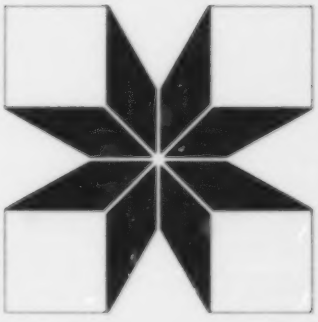
# SMALL RUMINANTS RESEARCH AND DEVELOPMENT IN THE NEAR EAST

PROCEEDINGS OF A WORKSHOP

HELD IN CAIRO, EGYPT,

2–4 NOVEMBER 1988



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# SMALL RUMINANTS RESEARCH AND DEVELOPMENT IN THE NEAR EAST

Proceedings of a workshop
held in Cairo, Egypt, 2-4 November 1988

Editor: A.M. Aboul-Naga

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**ORGANIZING AND SCIENTIFIC COMMITTEE**

| | |
|---|---|
| **A.M. Aboul-Naga,** | Animal Production Research Institute (APRI), MOA, Egypt. |
| **E.S.E. Galal,** | Ain Shams, University, Egypt. |
| **M.B. Aboul-Ela,** | Mansoura University, Egypt. |
| **Ferial Hassan,** | APRI, MOA, Egypt. |
| **M. El-Serafy,** | Ain Shams, University, Egypt. |
| **Eglal Rashed,** | IDRC, Cairo. |

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## FOREWORD

*Small ruminants (SR) are important in agricultural enterprises in the Near East (NE) region, and are the basic source of animal protein and cash to large communities in the region. NE region raises more than one fifth of the world's sheep and goat population and the demand for their products are rapidly increasing in the region.*

*On the basis of these considerations, the Near Wast Regional Cooperative Research and Development Network on Small Ruminants was established the first of its kind in the region. The Technical Consultation of the NE Regional Cooperative Research and Development Network on Small Ruminants held in Rome in 22-24 October 1986, recommended successive regional workshops on SR research and development. Ministry of Agriculture (MOA), Egypt took the initiative to host the 1st SR workshop in the NE region held in Cairo 2-4 November, 1988.*

*The International Development Research Centre (IDRC) significantly collaborated with MOA, Egypt in holding and sponsering the workshop. FAO-NE Regional office, has supported the workshop as an activity of the NE- SR network.*

*The workshop was planned to coincide with the International Symposium on Constraints and Potentialities of Ruminant Production in the Dry Subtropics, 5-7 November, 1988.*

*A. Aboul-Naga*

# THE ROLE OF SMALL RUMINANTS IN AGRICULTURAL SYSTEMS IN DEVELOPING COUNTRIES

C. R. W. SPEDDING

University of Reading, England

Small ruminants (sheep and goats) are numerous in many developing countries and, indeed, some 94% of the world's goats are to be found in developing countries. This is not the case for sheep which, for some reason, are frequently found in large flocks. This is easily explained where wool is the primary product (as in Australia, for example) but large meat-producing flocks are also found (in New Zealand and the UK, for example).

In Africa, small ruminants represent 24% of the total tropical livestock units in Western Africa and 17% in Eastern Africa (Peacock, 1984). They tend to be found rather more in drier areas and c. 58% of the sheep and c. 65% of the goats occur in arid and semi-arid zones of tropical Africa.

Their economic contribution is hard to determine, as they are often consumed at home, and this has led to some underestimation of their importance. This may be one reason why they have also often been neglected in research programmes (Knipscheer et al., 1987).

Small ruminants are frequently of considerable importance, however, with a whole range of advantages over other, larger livestock. They also have some disadvantages, of course, but the balance appears to be heavily in their favour. The advantages and disadvantages are summarized in Table 1. where they have been grouped in relation to their roles in exploiting the environment and in producing wanted products and services, and also in relation to their size.

Some of these features are repeated in more than one category and there are others, especially social roles, that do not fit easily into such a scheme. Similarly, some of the advantages are seen as more characteristic of sheep or goats. For example, in Indonesia, goats are preferred because they are easy to raise and house, they are prolific, use marginal land or live on crop residues, require little labour, provide manure and find a ready market (Knipscheer et al., 1984). There are 8 million goats in Indonesia, with 1 in 8 households keeping them, and they are mostly confined and fed on cut herbage. The labour involved is about ½ to 1 hour per goat per day. Amongst the Maasai, however, poorer

households preferred goats and richer ones sheep (King et al., 1984). The proportion of castrates increased with wealth and the proportions of cattle to sheep/goats was about 1:1, with 20% more sheep than goats. In Mali, some smallstock, mainly male sheep, are kept intensively (especially for Moslem feasts) but, as with most West African animal husbandry, the majority are kept extensively (Kolff and Wilson, 1985).

TABLE 1

Advantages and Disadvantages of Small Ruminants :

Environment

Advantages

- Less adversely affected by drought and reproduce more rapidly afterwards.
- Do not compete for land with crops. Thus especially useful for landless people.
- Make use of household wastes.
- Make better use of forbs, as these are more palatable to smallstock. Better able to exploit degraded habitats.

Disadvantages

- More animals have to be kept to meet the needs of a family.
- May be damaging to the environment if uncontrolled (but this has been greatly exaggerated (Peacock, 1984).

Products and Production

Advantages

- Small carcasses can be consumed by families without storage.
- Considerable scope for increases in performance and productivity.
- Low labour requirements (often herded by children).

Disadvantages

- Often susceptible to disease.
- Mating is more difficult to control.
- Not capable of providing power for cultivations.

Small size

Advantages

- Easy to manage.
- Simple housing.
- Low capital investment and hence low risk.
- No need to store products.

Disadvantages

- Susceptible to predators.
- More easily stolen.
- No use for power.

Dwarf goats and sheep are widespread in the humid zone of West Africa, with the enormous advantage of being trypanotolerant (Upton, 1985). They serve mainly as a supplement to cash and food crop production. Indeed, they have been described by Oyenuga (1967) as "a low labour input and low priority adjunct to traditional arable and cash crop farming".

In Nigeria, most small ruminants are kept in free-ranging village flocks with no special provision of forage or housing. In Kenya, however, the Maasai have to provide thorn enclosures to protect smallstock from predators (Peacock, 1984).

There are thus considerable variations in the systems of production and methods of keeping small ruminants. Intensive, housed and fed systems occur at one extreme and extensive, herded flocks, as in Morocco (El Aich, 1986), are also found.

The precise role of small ruminants varies between these systems but, in general, they are used in developing countries to utilize resources that might otherwise be wasted. Household residues (e.g. cassava peel) that might not be available in sufficient quantity for larger animals, roadside verges and sparsely-vegetated hillsides look very different from each other but they are all examples of such resources.

Of course, grazing animals also influence the botanical composition of vegetation. In the goat-grazed Mediterranean Maquis, for example, vegetation is characterized by the abundance of spiny shrubs and aromatic, sticky herbs (Crawley, 1983).

Ruthenberg (1976) summarized the situation as follows: "In particularly dry, stony areas far from markets, sheep-keeping predominants (southwest Africa, Australia, southern Argentina). Cattle do not have the same mobility and are more demanding with regard to the frequency of watering and the amount of water. Whereas sheep are kept in some cases where only 150 mm of rain fall annually, cattle-keeping usually requires more than 400 mm."

Ruthenberg (1976) pointed out that ranching may occur where arable farming is possible in terms of water supply but where labour is scarce and markets unavailable. An example is Karakul ranching in Namibia (S. W. Africa) where mutton is a by-product and the skins are taken immediately after birth so that there is no stress on the ewes during the dry season.

In some circumstances, mixtures of sheep and goats (and of small and large ruminants) may make more effective use of the environment, because of their different grazing and browsing habits and preferences.

Small ruminants, because of their relatively rapid breeding cycles and short time to reach slaughter weight, can often make better use of seasonally-varied herbage production. This is so in developed countries like the UK where the seasonality is due to low winter temperatures but it also applies in developing countries where seasonality is generally due to drought. Adaptations to this also occur in terms of those breeds that deposit specific fat reserves, as with fat-tailed sheep. One example of this is "transhumance", which occurs in the Mediterranean basin in response to summer drought, animals being fed in the plains in winter and spring and driven to the upland pastures in summer (Grigg, 1974).

**Products and Production**

Sheep and goats produce useful skins, wool, fibre, milk, manure and meat but in many developing countries it is the meat that is most important. This is often for ceremonies, some social, some religious; in southwest Nigeria, for example, sheep are slaughtered in religious ceremonies and goats for all kinds of celebrations (Okali and Sumberg, 1985). But in other countries, other products are important. In Indonesia, for example, skins and hides are exported and, in central Java, 30% of the farmers keeping sheep and goats (the commonest livestock after poultry) rated manure for high value crops as the most important product (Knipscheer et al., 1987). Products may be used to generate cash income but even where production is market oriented, as in Northeast Brazil, there is also much home consumption (Gutierrez-Aleman and De Boer, 1986).

Where meat is the main product, it is often important as a protein supplement to a largely-carbohydrate diet. This is the case in the humid tropics where root crops, such as cassava and yam, are the staple foods (Upton, 1988).

The demand for meat increases with population growth (and with increasing affluence) and there are therefore market opportunities. Productivity can be high, largely because of the relatively high reproductive rate. This allows quick recovery after bad times and high productivity in good times. The West African Dwarf goat, for example, is capable of kidding every 8 months, with an average of 1.5 kids each time, from the age of about 18 months. It can thus produce

an average of 2 kids per year, although high mortality (half die in their first year) generally reduces this. The actual annual yield is about 38% of the weight of the breeding female and the return on capital about 34% (Upton, 1988).

The Small Ruminant and Camel Group of ILCA (The International Livestock Center for Africa) has made a study of the reproductive capacity of sheep and goats and found (ILCA, 1986/87) that reproductive performance tended to be better in traditional systems where little breeding control was imposed.

They found that litter size in goats varied from 1.16 (in Mali) to 1.75 (in Rwanda) and in sheep from 1.02 (in Burkino Faso) to 1.43 (in Rwanda). But, using variations in the parturition interval (from 238-391 days in goats and from 230-406 days in sheep), the range of annual reproductive rates varied from 1.47-2.41 live young per year in goats, and from 1.23-1.95 in sheep. Thus, in African small ruminants, they argue that the annual reproductive rate should be governed not only by litter size, but also by manipulation of parturition intervals so that they are optimal.

The potential for greater productivity depends upon improvements to the environment and the feed supply, and better management, especially in terms of disease control and offtake.

Diseases such as PPR (Peste des Petits Ruminants) can cause havoc and poor feed often limits production. However, where trypanosomiasis is prevalent, poultry, dwarf goats and sheep are kept because they are less affected.

Untreated straw can actually form a high proportion of the diet of goats, provided that 50% of refusals is allowed (Wahed and Owen, 1988).

But in some parts of Africa, the shrub trimmings of Glizicidia and Leucaena in alley-cropping systems offer better scope for improved nutrition.

In some places, of course, the productivity of the best farmers matches that achieved at research stations (Knipscheer et al., 1984, writing about Indonesia).

**Social Implications**

In addition to those already mentioned, there are some other social effects. When sheep are owned by women, they may contribute to their independence and improve their

social position (Kolff and Wilson, 1985). However, Okali and Sumberg (1985) found that, in Nigeria, goats suited women better because they tended to roam less. These authors also recorded a marked interaction between livestock ownership and household decision making.

These interactions illustrate the need for a systems approach to the role of small ruminants.

**A Systems Approach**

One component, such as smallstock, cannot be looked at in isolation. As has been said, they interact with the environment, they have nutritional and social implications, they serve many different functions, social, religious and economic, they thus interact with markets (where the animals are traded), and they represent wealth, status, liquidity and insurance against risk.

They tend to be a greater proportion of the total wealth of poor families (Peacock, 1984) and improvement of small ruminants may therefore be a way of helping the welfare of the poor (Peacock, 1987).

It is natural, then, that attempts have been made to apply modelling techniques to such systems (e.g. Gutierrez-Aleman and De Boer, 1986, for Northeast Brazil; Orsini and Arnold, 1986, in Australia but a model that is relevant to Mediterranean environments). Linear programming has been used but it is not surprising that El-Shishiny et al. (1987) found it necessary to use goal programming, an extension to linear programming, for multi-objectives cases: a model devised for the local Rahmani Egyptian sheep.

But in many circumstances, it will not be possible to quantify the relationships involved and data will not be available for mathematical model-building. This could be due to lack of information because research has not been done or because smallstock are closely integrated with people in such a way that research is not possible.

This does not mean that a systems approach is not required. On the contrary, it is probably essential: but it has to use a more qualitative methodology. It has to apply the approach rather than the techniques that are commonly associated with it.

There is thus a need to quantify the contributions that small ruminants make to people in developing countries within systems which themselves cannot always be quantitatively described.

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# SELECTION FOR IMPROVED REPRODUCTIVE PERFORMANCE OF NATIVE SHEEP

J. P. HANRAHAN

The Agricultural Institute, Belclare, Tuam, Co. Galway, Ireland

## ABSTRACT

The annual reproductive rate is determined by prolificacy and the frequency of lambing. Information on the extent of genetic variation in these traits is briefly summarized. Results of selection for increased litter size in the native Galway breed show that the response is attributable to changes in ovulation rate. The merits of starting selection lines by screening large populations are briefly reviewed and results from such a selection study are presented. These again confirm the central contribution of ovulation rate. Selection for extreme reproductive performance in a foreign breed may facilitate the use of such genetic sources for the improvement of native populations with minimum impact on adaptedness. Results from selection for high ovulation rate in Finn sheep are considered from this view point. Selection for litter size or ovulation rate has significant effects on components of the breeding season but these are not consistent among breeds.

## INTRODUCTION

The annual reproductive rate of sheep is a major determinant of production efficiency. The principal sources of variation in the rate of reproduction are prolificacy and frequency of lambing. The former trait has been the subject of a large number of studies under many different production conditions and it is clear that there is a wealth of genetic variation both within and among populations (Hanrahan, 1982). In the case of frequency of lambing the amount of information on genetic variation within populations is rather limited. Studies of breed differences in length of the breeding season, and hence the possibility of frequent breeding, have shown that considerable differences exist among breeds developed and maintained in temperate latitudes (Hanrahan and Quirke, 1986). It is well known that breeds native to tropical and subtropical regions do not exhibit a distinct anoestrus season although the incidence of oestrus

is usually depressed in Spring (Aboul-Naga, 1985; Aboul-Naga, Aboul-Ela and Mansour, 1987).

The large differences among breeds in prolificacy have led to widespread investigation of the use of prolific breeds as a source of genetic material to raise the reproductive rate of native breeds by increasing prolificacy. In recent years the discovery of the Booroola gene, which dramatically increases litter size (Piper and Bindon, 1982), has led to a new phase of research related to increasing reproductive rate by introducing this gene into populations with low prolificacy levels. The exploitation of this type of genetic material for increasing the reproductive rate of native populations has the advantage that the desirable characteristics of adapted native breeds can be preserved when such major genes are incorporated by a system of repeated backcrossing to the native population combined with selection for the gene in question. Such a backcrossing programme will involve a considerable period of time depending on the desired level of native breed ancestry and methods available for determining the genotype of individual animals. Evidence for the existence of genes with large effects on reproductive rate in other sheep populations, such as Icelandic sheep (Jonmundsson and Adalsteinsson, 1985), the Cambridge breed (Hanrahan and Owen, 1985), Indonesian sheep (Bradford et al., 1986) and possibly the D'Man breed in Morocco (Lahlou Kassi and Marie, 1985) suggests that by using the most appropriate breed as a source for a major gene the amount of backcrossing required to maintain other traits at the desired level can be reduced. This would minimize the time and effort involved in exploiting such genetic variation. However, one difficulty with such genetic effects would remain, namely, the fact that the effects of these genes are so large that the increased reproductive rate would be such that prevailing production systems may be inadequate to ensure real production benefits. This would be especially true for homozygous individuals and consequently, accurate information would be required on the genotype of individual animals, especially males, for effective exploitation of such genes in many situations. In the absence of biochemical criteria for determining individual genotypes this will require progeny testing of males which may be difficult to organize in many circumstances. Consequently, increasing prolificacy by within population selection may be the only realistic approach in some cases.

Consideration of the problem of increasing the frequency of lambing raises the same questions as those connected with approaches to increasing prolificacy. Information on available genetic variation is however much more limited.

While large breed differences exist the expression of these differences is likely to be much more dependent on environment, especially latitude, than is the case for prolificacy. While single gene effects on length of the breeding season have been found (Drymundsson and Adalsteinsson, 1980) they appear to be much less dramatic than in the case of prolificacy.

In the present paper results of selection for increased prolificacy in Irish sheep are reviewed together with results on the exploitation of the large amount of genetic variation for ovulation rate in Finn sheep to provide an exceptionally high ovulation rate line of Finn sheep. Such a line could be used to provide a genetic lift in the reproductive rate of target populations with a smaller fraction of Finn ancestry than was possible heretofore.

## SELECTION FOR INCREASED PROLIFICACY IN GALWAY SHEEP

The Galway is a native Irish breed with a modest level of prolificacy and a clearly defined breeding season (Hanrahan and Quirke, 1985, Quirke et al., 1986). Selection for increased litter size was initiated in 1963 and a control line was also maintained. The details of the selection programme and the observed responses were reported by Hanrahan (1984). The main features of the responses observed are summarized in Table 1. These show a significant response in litter size which is attributable to a correlated change in ovulation rate. An estimate of the annual rate of improvement in litter size was 0.023±0.009 (Hanrahan, 1984) which is equivalent to 1.5% of the control line mean. Mean ovulation rate in 1985 and 1986 together with the resulting litter size is summarized in Table 2. The data on 4- and 5-year old ewes in this table refer to a random sample of 1982 born ewes. The effect of selection on ovulation rate and litter size for 2-year old ewes is consistent with the earlier results (Table 1). However, the agreement between results for mature ewes is not quite as good. The evidence suggests that the divergence between the lines for litter size is reduced at older ages and based on the results in Table 2 this is attributable to a reduced divergence in ovulation rate. However, this interpretation is not supported by the earlier results (Table 1). Further evidence needs to be acquired on this point.

The results in Table 2 were averaged over years and the observed and expected litter sizes were compared using the expression given by Hanrahan (1982). The results of these calculations are presented in Table 3. The agreement between observed and predicted mean litter size is quite

good indicating that the response to selection for increased litter size is attributable to changes in ovulation rate. This is consistent with the conclusion that variation in embryo survival is a minor source of genetic variation in litter size in sheep (Hanrahan and Quirke, 1986).

TABLE 1

Response to selection for increased litter size in Galway sheep*

| Ewe age | Line | Fertility (%) | Litter size | Ovulation rate |
|---|---|---|---|---|
| 2 | Control | 78 | 1.21 | 1.34 |
| | Selection | 81 | 1.47 | 1.62 |
| 3 | Control | 90 | 1.44 | 1.39 |
| | Selection | 91 | 1.70 | 1.65 |
| 4 | Control | 79 | 1.61 | 1.56 |
| | Selection | 95 | 1.71 | 1.99 |

* Adapted from Hanrahan (1984).

TABLE 2

Ovulation rate and litter size in Galway sheep.

| Ewe age | Year | Line | Ovulation rate | Litter size |
|---|---|---|---|---|
| 2 | 1985/86 | Control | 1.62±0.11 | 1.40±0.11 |
| | | Selection | 1.94±0.10 | 1.65±0.08 |
| 2 | 1986/87 | Control | 1.55±0.14 | 1.37±0.11 |
| | | Selection | 1.94±0.07 | 1.73±0.09 |
| 4 | 1985/86 | Control | 2.00±0.09 | 1.71±0.16 |
| | | Selection | 2.13±0.13 | 1.77±0.13 |
| 5 | 1986/87 | Control | 1.78±0.19 | 1.62±0.14 |
| | | Selection | 1.95±0.09 | 1.74±0.10 |

TABLE 3

Comparison of observed and predicted litter size for Galway ewes.

| Ewe age | Line | Ovulation rate | Litter size | |
|---|---|---|---|---|
| | | | Observed | Predicted * |
| 2 | Control | 1.58 | 1.38 | 1.42 |
| | Selection | 1.94 | 1.69 | 1.66 |
| 4+ | Control | 1.89 | 1.66 | 1.63 |
| | Selection | 2.04 | 1.75 | 1.72 |

* Using the equation of Hanrahan (1982).

## INCREASING PROLIFICACY BY SCREENING COMMERCIAL FLOCKS

The response to selection is the product of selection differential and heritability which together with the generation interval determine the annual rate of genetic improvement. Usually increasing the selection differential will automatically extend the generation interval unless reproductive rate per selected individual is increased as, for example, in systems based on superovulation of selected females followed by collection of embryos and their transfer to recipient females (Hanrahan and Quirke 1982). The potential for such MOET schemes in sheep have been examined by Smith (1986). Another situation which allows a substantial increase in selection differential without any consequences for generation interval is the initiation of selection programmes by applying extreme selection in a sufficiently large population to provide adequate foundation animals. Continued selection among the progeny of these foundation stock will of course be subject to the usual constraints connecting selection intensity and generation interval. The obvious benefits of such intensive screening is that an immediate significant genetic improvement should be obtained. A further benefit is that the likelihood of favorable genes at low frequencies contributing to response to further selection is enhanced because the frequency of such genes in the foundation group will be increased. A final point is that for traits such as litter size, which have a discrete distribution, the selection pressure which can be applied depends upon the relative frequency of the different levels of the trait (e.g. singles or twins). Screening of foundation animals will increase the mean of their progeny and in breeds of low prolificacy this increase can substantially increase the possible rate of further progress - especially in the initial generations.

Selection for increased litter size was initiated in Ireland in 1963 by using the screening approach. The criteria for choosing foundation animals were: (a) any ewe which gave birth to four or more lambs in any year, (b) a ewe which gave birth to nine or more lambs over three consecutive lambings, (c) foundation rams were from ewes which would qualify under (a) or (b). Details on the foundation animals and other aspects of this study have been given by Hanrahan (1984). After the assembly of foundation animals the flock was closed and selection was continued, based on litter size. However, some ewes were crossed with Finnish Landrace rams and not all of the resulting progeny were culled so that some Finn ancestry was incorporated (5.3%, Hanrahan, 1984). No breed restrictions were imposed on the foundation stock so that the initial selection pressure operated on genetic differences among and within breeds and crossbreeds. Unfortunately there was no attempt to form a control flock to facilitate the estimation of genetic improvement but based on various lines of circumstantial evidence genetic improvement of litter size was achieved (Hanrahan, 1984). Thus, information on the reproductive performance in lowland sheep flocks in Ireland about the time when the foundation animals were born indicates a litter size of 1.5 to 1.6 at most. Even allowing for breed differences in prolificacy it seems unrealistic to assume that the average litter size of unselected foundation ewes of the same average composition as the selected individuals could have been higher than 1.7. This value is consistent with a repeatability of 0.2 and the observed decline in litter size between on-farm and post-purchase records. The litter size of this flock increased significantly over time when measured as unadjusted phenotepic trend or as a deviation from the Galway Control line. The deviation of litter size from the Galway Control line increased by 0.029±0.007 per year between 1970 and 1982 inclusive.

Data on ovulation rate and litter size of mature ewes from this High Fertility line for the years 1982 to 1985 are summarised in Table 4. The litter size data do not refer in all cases to those ewes which provided ovulation rate information. The predicted litter size, using the mean ovulation rate, is 2.02 using the formula of Hanrahan (1982). While the observed litter size is somewhat higher than this prediction the difference does not approach significance which suggests that the intense selection for litter size involved in developing this line of sheep has had no major impact on embryo survival.

TABLE 4

Ovulation rate and litter size of mature High Fertility ewes*

| | No. | Mean | Range | CV % |
|---|---|---|---|---|
| Ovulation rate | 78 | 2.55±0.10 | 1-6 | 33 |
| Litter size | 91 | 2.13±0.08 | 1-4 | 35 |

* Data for 1982 to 1985.

**SELECTION ON OVULATION RATE IN FINN SHEEP**

The heritability of ovulation rate in Finn sheep is about 0.5 (Hanrahan and Quirke 1985) and divergent selection on ovulation rate at 18-months of age was initiated in 1976. Mean ovulation rate data for the three lines involved in this study were given by Hanrahan (1987) and showed a divergence of about 2 ova between the High and Low lines. High line ewes have an ovulation rate which is 1.44±0.07 times the mean of the control line. The possibilities for exploiting this high ovulation rate line to increase the prolificacy of local breeds were considered by Hanrahan (1987) where it was indicated that using 25% Finn ancestry would generate the same prolificacy as that attainable by using 50% ancestry from the unselected Finn line. Results for ovulation rate and litter size of 1/4 Finn x 3/4 Galway ewes generated by using rams from the High ovulation rate line are given in Table 5 together with values for contemporary Galway ewes.

TABLE 5

Ovulation rate and litter size of 1/4 Finn x 3/4 Galway ewes and contemporary Galway ewes.

| | Ovulation rate | Litter size |
|---|---|---|
| 1/4 Finn x 3/4 Galway | 2.80 | 2.05 |
| Galway control | 1.75 | 1.35 |

These results are consistent with the expectation that the use of genetic material from the high ovulation rate line can reduce the proportion of Finn ancestry required to increase prolificacy of a target population. Work is

currently underway on the use of the high ovulation rate Finn line in combination with the Texel sheep to develop a high prolificacy composite breed with improved carcass merit. Finn sheep and Texels are being crossed to produce 1/4 Finn x 3/4 Texel animals. The ovulation rates of F1 ewe lambs born in 1988 are given in Table 6. The High-line cross has an ovulation rate which is significantly greater than F1 animals from the other two lines and the superiority of the High line cross over the control cross (+28%) is consistent with the divergence between the purebred Finn lines.

TABLE 6

Ovulation rate of Finn x Texel (F1) ewe lambs.

| Crossbred type | No. of lambs | Ovulation rate |
|---|---|---|
| Finn High line x Texel | 27 | 1.78±0.08 |
| Finn Control line x Texel | 14 | 1.39±0.12 |
| Finn Low line x Texel | 18 | 1.32±0.10 |

## CORRELATED CHANGES IN BREEDING SEASON

The effects of selection for litter size and ovulation rate on components of the breeding season have been examined in the Galway and Finnsheep populations at our Institute. In the case of the Galway selection line the date of first oestrus of the breeding season was established for random samples of mature ewes in 1986 and again in 1987. Ovulation rate at the first oestrus of the season was also recorded in 1986. The results are given in Table 7. Ewes from the selection line had a slightly later onset of cyclicity in both years but these differences were not significant. However, when the line differences were pooled across years the mean difference of 6.5 days was significant ($t = 2.26$, $P < 0.05$).

In 1986 the difference between the lines for ovulation rate at first oestrus was consistent with differences between these lines during the breeding season (Table 2).

In the case of the Finn breed selection for increased ovulation rate was associated with a significant increase in the duration of the breeding season which was largely attributable to later cessation of cyclicity in the Spring although the High line ewes starting cycling slightly earlier in the Autumn (Table 8).

TABLE 7

Correlated response in date of onset of the breeding season in Galway ewes.

| Ewe age | Line | No. of ewes | Date of First oestrus | Ovulation rate* |
|---|---|---|---|---|
| 4.5 | Control | 14 | 14.9.86±3.5 | 1.64±0.15 |
| | Selection | 19 | 19.9.86±3.0 | 2.00±0.12 |
| 2.5 | Control | 19 | 6.10.87±3.1 | - |
| | Selection | 35 | 14.10.87±1.5 | - |

* At first oestrus of the breeding season.

TABLE 8

Correlated changes in the duration of the anoestrus in Finn ewes selected for ovulation rate.

| Trait | Line | | |
|---|---|---|---|
| | High | Low | Control |
| Duration of the anoestrus (days) | | | |
| - 1985 | 124±4.6 | 157±5.2 | 132±4.9 |
| - 1986 | 126±5.9 | 146±5.6 | 143±5.3 |
| - average | 125±3.7 | 152±3.8 | 138±3.6 |
| Date of onset of the breeding season | Oct.2±3.1 | Oct.9±2.8 | Oct.9±2.8 |
| Date of onset of the anoestrus | May 30±3.6 | May 8±3.3 | May 23±3.3 |

The results from these two selection experiments yield opposite trends in relation to the genetic association between reproductive rate and date of onset the breeding season. These conflicting results are not inconsistent with literature on this topic reviewed by Hanrahan and Quirke (1986).

## CONCLUSIONS

It is clear from the results reviewed that within breed selection for increased prolificacy is successful and

especially when initial selection is based on screening of individuals with extreme performance from native populations. The additional option of exploiting genes with a large effect on ovulation rate to enhance the reproductive rate of a target population allows the preservation of the genetic background of adapted local breeds. An alternative procedure is to select for increased ovulation rate in a prolific breed to be used for upgrading a target population.

Results from selection for increased prolificacy show that responses are mediated via changes in ovulation rate. The advantages of using ovulation rate as the selection criterion for increasing prolificacy have been discussed elsewhere (Hanrahan, 1987). These advantages should be exploited in selection programmes aimed at increasing litter size in native populations.

Information on the genetic association between seasonality of breeding and prolificacy appears equivocal with conflicting evidence between populations.

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# SELECTION FOR REDUCED SEASONALITY IN SHEEP

G. RICORDEAU

INRA, Station d'Amélioration Génétique des animaux
BP 27, 31326 CASTANET TOLOSAN CEDEX, FRANCE

## ABSTRACT

The choice of the mating period or reproductive system depends on the fodder resources during the year as well as ewe genetic potential. Aseasonality aptitude depends on the reproduction system used. This is measured by criteria which are repeatable but weakly heritable. Various reproduction systems are analyzed. 1) Temporary acceleration of the reproductive rhythm with principal mating in spring (Mérinos d'Arles system) or at the beginning of the season (INRA 401 system) ; 2) continuous mating; 3) systems with 2 or 3 annualy mating periods, i.e. 4 lambing in 3 years or 3 lambings in two years. These various systems require standardization of ewe-lamb mating if one wants to set up a selection programme. Possible criteria may be the fertility of first or first two matings, out of season fertility, or out of season post-partum, or lambing intervals.

Selection on aseasonality aptitude is possible but it must be done with priority and directly on fertility. It must be performed in farms in order to detect hyperfertile ewes. This type of selection can be efficient if the means put at one's disposal are used : indexation of a maximum number of ewes in farms, planned matings of superior dams with the very best rams, performance-test selection, and progeny test of sires. Performance recording in farms is essential if a correct estimation of "ewe index" for aseasonality in the various situations and of the genetic and phenotypic variability of this trait is to be obtained. The estimation of variability in the local breeds is a priority before introduction of a new breed or with respect to crossbreeding.

## PHYSIO-GENETIC DETERMINANT OF SEASONAL AND POST-PARTUM SEXUAL ACTIVITY

1) The sexual activity of females is at the maximum during

the periods of decreasing daylight, but there are large between and within-breed variations in the length of the breeding season, the dates of onset and end of breeding season, and the age at first oestrus (Hafez, 1952; Land et al., 1973; Ortavant et al., 1985; Aboul-Naga et al., 1985; Hanrahan and Quirke, 1986; Notter, 1986; Quirke et al., 1986; Hanrahan, 1987; Lindsay and Thimonier, 1988; Avdi et al., 1988).
Similarly, in adult ram (Ile de France), sperm fertility and morphological abnormalities are more frequent from January to June, with a maximum in March, but with large individual differences (Colas, 1980, 1981; Colas et al., 1988).

2) Within-breed, the breeding season is characterized by an oestrus-ovulation dissociation (silent ovulations) throughout the year, so that ceasing of ovarian activity is observed less often than suppression of oestrus behaviour (Thimonier and Mauléon, 1969).

3) Teasing (reintroduction of rams after a period of isolation) stimulates ewes to ovulate and commence their oestrous cycle. Response to teasing varies according to the stage of non-breeding season, and the breed of ewes and rams (Oldahm et al., 1980).

4) The breeding season of ewe-lambs is shorter than that of the adult (Hafez, 1952; Walrave et al. 1975) but a striking similarity exists between the mechanism governing the onset of puberty in the lamb and the onset of the annual breeding season in the adult (Foster and Ryan, 1979; Foster, 1981), accordingly the sexual activity of ewe-lambs may be a good selection criteria.

5) The duration and onset of the breeding season of $F_1$ ewes are intermediate between that of the two parents (Hafez, 1952). There is a close relationship (0.36 to 0.80) between the date of first oestrus and breeding season length (Walrave et al., 1975) or the number of heats per ewe/season. Thus for building up strains of sheep to give two lamb crops a year, one would select from individuals of early onset (Hafez, 1952).

6) After lambing, there is also an oestrus-ovulation dissociation: silent ovulations occurs rapidly (Mauléon and Dauzier, 1965; Hunter, 1968), but anomalies in the intervals between the first oestruses can be observed (short cycles of 4 to 9 days and normal cycles : Tchamitchian et al., 1973b), thus fertility is reduced during 40 days post-partum. In the same way, in season or out-of-season, the fertility rate after A.I. following

induced oestrus increases with the interval from parturition to A.I. (Thimonier et al., 1968; Cogni et al., 1975). A breed influence and a breed x treatment interaction on the response to hormonal treatment for percentage of ewes lambing was reported (Laster and Glimp, 1974).

7) Out-of-season post-partum sexual activity (April-May) has an additive determinism (Ricordeau et al., 1976) and there is considerable between and within breed variation in the length of post-partum anoestrus, which could provide scope for selection (Hafez, 1952; Van Niekerk and Mulder, 1965; Ch'ang, 1973). The average estimates of paternal heterosis effects was 1.4 % for seasonal fertility (summer to winter) vs. 29.5% on fertility during spring breeding (Leymaster, 1987). In an 8 months lambing system, the maternal heterosis was 36 % (Visscher, 1987).

8) The capacity of rams to produce a high production of semen all the year can be increased by alternance of short and long days every month (Pelletier et al., 1985; Pelletier et Almeida, 1987). However, the response of ram-lambs, born in Autumn, to a photoperiodic control is more marked in the seasonal breeds (Colas et al., 1987; Poulton and Robinson, 1987).

9) In deer mice, the selection for or against reproductive photoresponsiveness gives significant divergent results in only two generations (Desjardins et al., 1986). That divergence confirms a genetic bases for the variation in reproductive performance and suggests that this trait has a high heritability.

10) In permanent breeding rhythm in ewes, there seems to be an incompatibility between lambing interval and litter size (Brelurut, 1987; Hoeke and Visscher, 1987; Tchamitchian, 1988). This incompatibility exists also in mice between permanent breeding and increasing litter size (Wallinga and Bakker, 1978).

## SELECTION CRITERIA FOR MEASURING OUT-OF-SEASON BREEDING CAPACITY

In theory, it is possible to obtain 2 lambings per year, but it is necessary to select ewes capable of exhibiting oestrus the whole year and of being fertilized rapidly after lambing whatever the season. Permanent oestrus control in non-breeding ewes allows to measure the sexual activity, but it does not give an accurate idea of the animal

productivity, depending on the number of matings, the inhibitory effects of post-partum anoestrus and lactation, and the favourable effects of stimuli such as introduction of the ram. This, the out-of-season breeding capacity can only be measured relative to the reproduction system.

We have to distinguish 3 types of situations :

1) Principal mating early in the season for obtaining one lambing per year.
2) Temporary accelerated mating system with 2 symmetrical alternatives : first mating of ewe-lambs in-season in a system with principal mating out-of-season; first mating of ewe-lambs out-of-season in a system with principal mating in season.
3) Permanent accelerated breeding rhythm, with several mating periods, to obtain lambings with 6, 8 or 9 months intervals.

**A. Principal Breeding Early in the Season**

The date of first oestrous is repeatable and heritable (Table 1). Thrift et al., (1971) showed that selection on date of birth can advance the date of lambing and prolificacy. The number of hogget oestruses is also heritable and can be used for indirect selection on reproduction rate (Dalton and Rae, 1978), but the genetic correlation with hogget weight is variable.

The ewe-lambs are generally mated at 8 or 18 months, except in the "INRA 401 mating system" (B2)

**B. Temporary Accelerated Mating System**

**1) Principal breeding season in May (out-of-season), with "cleanup" breeding in September for ewes failing to conceive in May (Fall lambing system)**

In this system, the ewe-lambs are mated for the first time in September (in season) at the age of 1 year (lambing in February-March of the following year) and are bred again together with adults, in May. This system can be applied to transhumant hardy breeds (Merinos d'Arles : Prud'hon and Denoy, 1969; Mountains Merinos : Timko, 1974) as well as to some lowland breeds (Ile de France). However, in the latter case, the farmers may advance the date of first breeding to obtain lambings in January and stagger the spring breeding to obtain maximum fecundity.

With this system, selection is made on fertility at the first two matings : the first one measures the precocity,

TABLE 1

Repeatability (r) and heritability ($h^2$) estimate for breeding season

| Traits | r | $h^2$ | |
|---|---|---|---|
| Data of onset breeding season, or date of 1st oestrus | 0.33 (6 est.) (0.12 to 0.52) | 0.22 (5 est.) (0.06 to 0.40) | (1) |
| Oestrus in the first 16 d mating | | 0.32 | |
| Cessation of breeding season | 0.25 (3) | 0.25 | |
| Duration of breeding season | 0.30 (3) | 0.30 | (2) |
| Fertility at natural oestrus | | 0 ; 0.11 | (4) |
| Fertility at synchronized oestrus | | 0 | (5) |

(1) Ricordeau, 1982; Hanrahan and Quirke, 1986; Owen et al., 1986;
(2) Quirke and Hanrahan, 1985; (3) Quirke et al., 1986;
(4) Aboul-Naga et al., 1985; (5) Shrestha and Heany, 1987.

the second one the out-of-season post-partum fertility. The analysis made on 63 progeny-tested rams Merinos in an extensive production system, showed that the heritability of fertility at 1 year was 0.27, and that the $h^2$ of post-partum fertility in May-June in lactating hoggets was low (0.17) but significant (Razungles et al., 1975).

This system has been tested in the U.S.A. and in Canada (Thrift and Whiteman, 1969) and selection has been made of two synthetic lines : Finnish x Dorset (Ringwall et al., 1980); 1/2 Dorset, Leicester, Suffolk (Fahmy et al., 1980).

**2) Principal breeding season in July-August (beginning season), with a first out-of-season mating in April (INRA 401 mating system).**

All the ewes are maintained in an accelerated mating system up to 3 years of age, without hormonal treatment, according to the following programme : born in December-January; first mating at 15 months in April-May and lambing in Sept-October; second post-partum mating in Oct-November and lambing in March-April; third and following matings in July-August. The two first matings are without

monitoring paternity; the following matings are reserved for replacement. Fertility is respectively 86,82 and 97%, with litter size of 1.7, 1.9 and 2.1. The heritability of fertility at the two first matings are 0.06 and 0.03, the $h^2$ of litter size being of 0.13 and 0.08 (Ricordeau et al., 1982 b,c; Razungles et al., 1985; Tchamitchian et al., 1986).

**C. Permanent Accelerated Mating Systems**

**1) Continuous breeding system**

A mean lambing interval of 7 months has been observed on Djallonké (Vallerand, 1979), Tabasco (Lazo et al., 1983) and Pelibuey ewes (Gonzales et al., 1987). In the other situations, this system does not allow to obtain a higher annual fertility than that registered in the system with 3 annual breeding periods (Ricordeau et al., 1972; Valls Ortiz, 1981). Terril and Lindahl (1975) obtained the first lambing interval of 316 days in their selection experiment started in 1966 with crossbred ewes (Morlam sheep). In Spain, the heritability of interval between lambings varies from 0.06 to 0.35 (Mallard and Mariné, 1983; Gabina, 1986).

**2) Twice yearly lambing system**

This system gives very good results in the D'man breed in Morocco, since the mean lambing interval is 192 days (Bouix and Kadiri, 1973, 1975). However, with European breeds, especially the prolific Finnish and Romanov breeds, the experiments have not given the expected results (Land and McClelland, 1971; Goot and Maijala, 1977; McNeal, 1978; Tchamitchian et al., 1973a, 1981).

**3) Three lambings in two years**

In 1973, More O'Ferral (1981) began a selection on Finnish x Dorset ewes, with matings in July, March and November, without hormones : the replacement rams were generally the latest born rams from the March mating and the earliest from the July mating. With this type of ewes, the anoestrus period ranged from April 12$^{th}$ to August 30$^{th}$, with a higher fertility in March than in July (70 vs 49%).

This system is applied in Spain (Valls Ortiz, 1981), in Egypt (Aboul-Naga and Aboul-Ela, 1985) and in Southern France, where the breeds with a prolonged breeding season are located : Préalpes du Sud, Lacaune and Caussenarde du Lot in particular (Tchamitchian and Ricordeau, 1974). It gives a supplement of 0.5 lamb/ewe vs. one lambing per year (Marzin et al., 1979; Notter, 1981; Valls Ortiz, 1983;

Gabina, 1986; Iniguez et al., 1986; Brelurut, 1987).

Breeding of ewe-lambs and genetic parameters: the 3 annual mating periods are schematically (February, June, October). Females used in reproduction are born in July and November, thus allowing the first mating at the age of 11 months in June or October, or more seldom at 7 months. Fertility at 1st mating varies with age and breeding season (Tchamitchian et al., 1981). Within breed, genetic variability is not easy to demonstrate : in the Caussenarde du Lot breed, only few A.I. are practised and matings are made with several rams to obtain a maximum post-partum fertility, the sire of the lambs is therefore often unknown. In the meat Lacaune breed, A.I. is practised on adults in March and June, and the rams are progeny tested. A fertility index and a prolificacy index are calculated for each sire according to the performances of their daughters mated in June, at 11 months. The correlation between these two indexes is between 0 and 0.21 (Bodin et al., 1979; c.p.); this means that to improve both fertility and litter size, it is necessary to select on both traits.

The capacity of breeding at an accelerated rhythm is repeatable since in March-April (out-of-season) ewes that lambed 2 to 4 months before breeding had 30% higher conception rate than ewes that lambed at least 7 months before breeding (Tchamitchian et al., 1981; Notter and Copenhaver, 1980). According to the estimates of repeatabilities of conception rate in crossbred ewes (Finnish x Rambouillet) with matings in April, August and November, Notter (1981) showed that decisions to improve fertility should probably be based on out-of-season (April) or early season (August) breeding performance.

**4) Four lambings in three years**

This system is being developed since 1982 in Caussenarde du Lot breed, which have a long breeding season (VAUR et al., 1984). This involves a principal mating in Spring (from April 25th to June 15th) where all ewes present are mated, and the Autumn mating (from October 15th to December 5th) only for ewes fecundated during the first 20 days of the last mating period. We thus avoid progressive slipping of the flock towards the Autumn mating period. The ewe-lambs born in Autumn are reserved for replacement and are mated at one year with a fertility rate of 90%. With this system, the possible rhythm is 1.33 lambings per ewe and per year but theoretically 2 lambings a year can be achieved by the best ewes.

This system is much more economical and has less work

involved since the whole herd can spend the summer on the dry pastures of the CAUSSE region without supplements. On the other hand it requires a good mastery of the techniques of natural synchronization of oestrus : flushing, ram effect after lamb-weaning (Tchamitchian, 1988).

TABLE 2

Repeatability and heritability of traits measured in accelerated mating system (according to Tchamitchian, 1988)

| (System) Breed | Traits | r | $h^2$ |
|---|---|---|---|
| (B1) Mèrinos d'Arles | Fertility at 1 year in sept. | | 0.25 |
| | Post-partum fertility in May | | 0.17 |
| (B2) INRA 401 | Fertility at 15 months in April | | 0.06 |
| | Post-partum fertility in October | | 0.03 |
| (C1) Spanish,Morlam | Lambing interval | 0.13;0.25 | 0.06 to 0.35 |
| (C3) Aragonaise | Ram introduction-fec. Interval | | |
| | in season | 0.09 | 0 to 0.30 |
| | May or July | 0.20 | 0.20 to 0.40 |
| | January or March | 0.18 | 0.15 to 0.30 |
| | Fertility at these matings | 0 | 0 |
| (C3) Finn crossbred | Fertility in April | 0.18 | 0 |
| | " " August | -- | NS |
| | " " November | -- | NS |

**EARLY CRITERIA AND MARKER GENES**

According to Lee and Land (1985), selection for testis growth has a favourable effect on the fertility at first service at 19 months. In the Lacaune breed, we observed a positive correlation between the testis diameter of young males at 120 days and the fertility of their daughters at 11 months in June, but that correlation was close to zero after correction for the live weight of males.

In Icelandic sheep, the allele $A^{wh}$ for white or tan colour, suppressed the occurrence of out-of-season breeding activity and lowered the incidence of repeated out-of-season breeding of individual ewes (Dyrmundsson and Adalsteinsson, 1980). However, in the INRA dam line, Ricordeau et al. (1982a) observed no or little differences in April or July.

## DISCUSSION AND CONCLUSIONS

Selection for reduced seasonality is possible, however, a certain number of conditions come into account.

1) The reproductive system must be well-adapted to environmental conditions (adjustment of fodder production to the needs of the ewes and lambs).

2) If we wish to make a selection upon the aptitude of aseasonality (or follow an accelerated rhythm), this characteristic must be considered first. Often selection is done on other criteria : Prolificacy, milk production, conformation...) and aptitude of aseasonality is not really taken into consideration, therefore, no real progress is made on this trait. In certain schemes, fertility performances are even lower, causing breeders to return to a reproduction system close to that of annual mating.

   Having been defined, the reproduction system must not be modified and ewe-lamb mating conditions must be standardized. Male and female reproductive indexes will be calculated with respect to female fertility during the first one or two matings.

3) Whatever the reproductive system is, in order to achieve planned matings of the best ewes and to produce the ewe-lambs necessary for replacement, a maximum number of ewes must be mated out of season.

4) Selection must be done in farms, in order to use maximum genetic variability and to retain the lambs born from hyperfertile mothers. Selection within closed experimental flocks is not desirable since these flocks are always of a limited number of animals and have reduced genetic variability. The performance recorded in the farms may consist of a single test of reproductive aptitudes (mating, lambing, litter size, including if possible a measurement of ewe milk production by the average daily gain 10-30 days of suckle lambs).

5) Depending on the goal to be achieved, various selective criteria can be retained : fertility at the beginning of the season or out of season, post-partum fertility out of season, fertility during the first or first two matings (or interval between first mating and second lambing). However, in all cases, the criteria retained must be measured before two years are up in order to avoid bias due to eliminations and to rapidly index the ewes and rams. This may incite breeders to improve sexual precocity, but it is not wise to mate ewe-lambs before the age of 10 months except under very favourable breeding conditions.

6) Direct selection of ewe fertility is the most efficient solution if one uses the means put at one's disposal : recording of performances in farms in order to detect hyperfertile females which produce young males; planned matings of the best parents; selection of young males into performance-test stations to measure their growth rate and semen production; progeny-test the rams by I.A. in order to obtain females from each sire in the various flocks. I.A.'s other concern is to create genetic "connections" between flocks, thus making indexes comparable and improving the efficiency of the various steps of selection.
If aseasonality aptitude depends on a major gene, selection of hyperfertile dams will be efficient and the analysis of their daughters will bring useful data.

7) Cross-breeding should only come about after exploring genetic variability of local breeds and taking into account their aptitudes on the whole (zootechnical performances, but also resistance to climatic conditions, to parasites, to diseases...)

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# NATIONAL BREEDING AND RECORDING SYSTEMS FOR SHEEP AND GOATS UNDER SEMI-INTENSIVE PRODUCTION CONDITIONS: THE CYPRUS EXPERIENCE

A. CONSTANTINOU

Department of Agriculture, Nicosia, Cyprus

## ABSTRACT

Semi-intensive sheep and goat production systems are gradually becoming more important in the Near East. Improving indigenous breeding stock to respond more efficiently to better management and feeding is therefore increasingly gaining momentum.

Performance recording is an important tool for identifying and selecting carriers of superior genes within a given population. In most countries, however, recording is restricted to central state-owned nucleus flocks. Stratified cooperative breeding systems operating on the basis of simplified production records, offer a practical solution to the problem of achieving a satisfactory degree of gene multiplication and dissemination through the population. Production records are also very useful for management purposes.

A simplified form of a hierarchical group breeding system for small ruminants is being implemented in Cyprus over the last 10-15 years. Central state-owned nucleus flocks of Chios sheep and Damascus goats comprise about 800 animals from each species. In addition 22 private sheep and 23 goat flocks keeping 3,300 animals from each species are recorded by trained technicians of the Department of Agriculture. Selection in the nucleuses is based on indices combining information of postweaning milk yield of the dam and weight of the progeny at 15 (lambs) or 20 (kids) weeks of age. Significant environmental effects are accounted for by multiplicative correction and breeding values in individual traits are expressed as deviations from year-flock averages. Recorded private units (multipliers) receive highest priority in aquiring high quality breeding stock from government stations and outstanding males raised in private flocks are sold further to non-recorded units.

Problems encountered in implementing effective breeding and recording systems include : traditionally founded preference to select male stock exhibiting typical external characteristics, rather than paying more attention to production; disposal of young male and female stock at an early age and before effective selection can be accomplished; higher phenotypic performance in some small private flocks, than in overcrowded and less well-managed government flocks.

## INTRODUCTION

From time immemorial sheep and goats played a major role as suppliers of meat, milk, wool, hair and skins to people of the Middle East.

The concept of performance recording and selection for higher production is not at all new to many farmers of the region. Roaming bedouin herders are known to be extremely good stockmen and several studies indicated that milking performance of the dam, external conformation and growth of the lamb constitute the main criteria applied by them when selecting male stock (e.g. Bhattacharya and Harb, 1973). On the other hand the same studies yielded evidence that concentrate supplementation is already rather heavy at times, partly in response to a deteriorating condition of the range, but also as a result of modified production systems that are more sedentary in character and more integrated in the overall farming process.

Integration of crop and livestock production, concentrate supplementation and the application of semi-intensive and intensive management practices are the main characteristics of the production systems prevailing in Cyprus today. Under these conditions the use of improved stock is critical to the success of the operation, both from a financial and from an economic point of view. This paper deals with the application of established selection theory and methodology to the improvement of sheep and goats and with the experiences gained in Cyprus in implementing hierarchical breeding and recording systems for this purpose.

In the case of goats it also provides information on the genetic and phenotypic parameters, which formed the basis for defining selection objectives and for constructing suitable selection indices.

## SOME ASPECTS OF GROUP BREEDING SYSTEMS APPLICABLE TO SMALL RUMINANTS

The basis of a group breeding system is a cooperative breeding hierarchy, which, in the simplest case, may consist of a central nucleus practising efficient selection and a number of dependent many fold flocks drawings rams from it. The benefits of selection can be increased by introducing a layer of multiplier flocks to the hierarchy. The effects of such a system on breed improvement were summarized by Bichard (1971). The rate of genetic progress eventually becomes the same for all members for the system, but the genetic level of dependent flocks lags behind by at least two generations, unless additional elements of selection among nucleus males moving downwards and among base flock females can be introduced.

The nature of a group breeding system is such that it is in the interest of all its members to secure that the nucleus has the highest possible genetic level and the highest possible rate of genetic progress. Conventionally this is achieved by using optimization procedures to define the criteria of selection and to construct suitable selection indices incorporating heritable traits of economic importance.

Opening the nucleus to receive a proportion of highly selected base flock females may increase the rate of genetic gain by a maximum of 10-15% (James, 1979).

## A BRIEF REVIEW OF SMALL RUMINANT BREEDING AND RECORDING SYSTEMS IN CYPRUS

Chios sheep and Damascus (Shami) goats are predominant in Cyprus. Both are dual-purpose breeds (meat, milk) and are known to be very prolific. Damascus goats were imported from Syria in the 40's and 50's and Chios sheep from Greece mainly in the 60's. A few nucleus flocks were formed on government stations at a very early stage and selection of male and female stock was based on measured production (Constantinou, 1981).

With the initiation at the beginning of the 70's of a Livestock Production Improvement Project (a joint undertaking between the Government of Cyprus, UNDP and FAO), selection and breeding work at government stations was intensified. Central flocks of more than 1,000 animals from each breed were established and records on dam's and sire's identity, litter size, lamb weight at various ages and post-weaning milk yield were collected on a routine basis.

Breeding stock was sold to private farmer at subsidized prices and a considerable number of demonstration flocks were established around the island.

In 1977 a new project aiming at the establishment of recorded private breeding flocks was initiated. Starting with 3 sheep and 8 goat flocks, the project expanded to cover 22 sheep and 23 goat flocks totalling 3300 animals from each species. Records are collected and analyzed by trained technicians of the Department of Agriculture and include dam's number, litter size at birth and at weaning, lamb weight at birth, at weaning and sometimes at a later age and post-weaning milk yield in 90 days. The latter is computed from at least three individual morning and evening recordings at monthly intervals.

Since both government nucleus flocks and private multiplier units operate under the supervision of the specialized services of the Ministry of Agriculture, every effort is made to secure a constant flow of breeding stock from the apex to the base of the pyramid. In short the procedures followed in this respect are as follows:

a) All male animals born in government stations are routinely evaluated in batches around the age of four to five months, on the basis of an index, about 20% are selected and retained in the stations, 30-40% are sold to private farmers and 40-50% are sold for meat.

b) Upon completion of the first three months of post-weaning lactation for all females in the flock the initial evaluation of male kids is reassessed, 5-10% are kept for breeding in the central flocks and the remaining 10-15% are offered for sale to private multiplier flocks.

c) Male selected animals are used for breeding in the stations from the first year of their life and are sold to multiplier flocks at the end of the subsequent breeding season, i.e. at about the age of 1.5-2.0 years.

d) Female animals born in the stations are evaluated using the same procedures and about 40% are selected as replacements. The remaining animals are sold to multiplier flocks and to other interested farmers.

e) Male, and to a lesser extent female breeding stock born in private recorded flocks are evaluated using simplified procedures. Outstanding males are selected for breeding (with some exchange among recorded flocks)

and other superior males are sold, depending on demand, to other interested farmers. Females not required for replacement purposes in multiplier flocks are very often sold to newly established private units and to other stock-owners, with the assistance of local livestock extension officers.

## SELECTION STRATEGIES APPLIED IN NUCLEUS AND PRIVATE RECORDED FLOCKS

Selection procedures were developed on the basis of genetic and phenotypic parameters, estimated using data from government stations (Tables 1 and 2 ). For Damascus goats, the conclusions drawn from genetic analyses completed sofar could be summarized as follows:

a) Genetic and phenotypic variability in milk yield is sufficient for selection to operate effectively. Milk production in 90 days after weaning can replace total milk yield as a criterion for selection, without reduction in expected response (Table 3).

b) There does not appear to be sufficient justification for including prolificacy in a multi-trait selection programme for Damascus goats. The results obtained suggest, that in this breed there is a definite genetic foundation for high litter size and that selection cannot do much to expand this base.

c) Kid growth rate appears to be very much affected by environmental factors and is less heritable than kid weight at weaning and at 140 days of age. 140-day weight is probably the best criterion to select for, given that weaning weight has the disadvantage of being a composite trait reflecting not only direct, but also maternal influences.

d) The genetic relationship between early growth and milk production is probably of negative nature. However, the estimates obtained sofar are not very reliable, because they are associated with high standard errors.

e) There appears to be a positive relationship between body weight and milk production or growth characters. When selecting for higher milk yield or kid weight some correlated responses in body weight can probably not be avoided.

TABLE 1

Heritability ($h^2$) and repeatability (t) estimates for milk yield, body weight, litter size and litter weight in Damascus goats[1].

| Character | $h^2$ | t | Reference |
|---|---|---|---|
| Post-weaning 90-day milk yield | 0.29 ± 0.14 | | Mavrogenis et al. (1984) |
| | 0.35 | 0.36 | Constantinou et al. (1985a) |
| | 0.29 ± 0.12 | 0.49 | Constantinou et al. (1985b) |
| | 0.69 ± 0.30 | | Constantinou et al. (1985b) |
| Post-weaning total milk yield | 0.29 ± 0.13 | | Mavrogenis et al. (1984) |
| | 0.29 | 0.39 | Constantinou et al. (1985a) |
| | 0.35 ± 0.13 | 0.46 | Constantinou et al. (1985b) |
| | 0.61 ± 0.30 | - | Constantinou et al. (1985b) |
| Body weight after kidding | 0.20 ± 0.11 | 0.65 | Constantinou et al. (1985b) |
| | 0.40 ± 0.29 | | Constantinou et al. (1985b) |
| Litter size at birth | 0.01 | 0.07 | Constantinou et al. (1985a) |
| | 0.01 ± 0.09 | 0.04 | Constantinou et al. (1985b) |
| | 0.14 ± 0.28 | - | Constantinou et al. (1985b) |
| Litter size at weaning | 0.00 | 0.08 | Constantinou et al. (1985a) |
| | - | 0.14 | Constantinou et al. (1985b) |
| | - | - | Constantinou et al. (1985b) |
| Litter weight at weaning | 0.02 | 0.09 | Constantinou et al. (1985a) |
| | - | 0.06 | Constantinou et al. (1985b) |
| | - | - | Constantinou et al. (1985b) |

[1]) In each case the last estimate of $h^2$ refers to two-year-old goats in their first or second lactation. Negative estimates are indicated by a (-).

TABLE 2.

Estimates of heritability for kid weight at various ages and for daily gain before and after weaning[1)].

| Character | Reference | |
|---|---|---|
| | Mavrogenis et al. (1984) | Constantinou et al. (1985b)[1)] |
| Birth weight | 0.31 ± 0.08 | 0.17 ± 0.28 |
| Weaning weight | 0.27 ± 0.07 | 0.47 ± 0.29 |
| 140-day weight | 0.24 ± 0.07 | 0.42 ± 0.29 |
| ADG to weaning | 0.16 ± 0.06 | 0.11 ± 0.27 |
| ADG weaning to 140 days | 0.22 ± 0.07 | 0.04 ± 0.27 |

[1)] This study refers to female kids only

TABLE 3.

Estimates of genetic and phenotypic correlation among growth and milk production characters[1]

| Character | Post-weaning milk production | | Body weight | |
|---|---|---|---|---|
| | in 90 days | total | | |
| | genetic correlation | genetic correlation | genetic correlation | phenotypic correlation |
| Weaning weight | -0.03±0.41 | -0.08±0.43 | 0.36±0.45 | 0.35 |
| 140-day weight | -0.44±0.47 | -0.30±0.47 | 0.20±0.51 | 0.42 |
| 90-day milk yield | | | 0.18±0.43 | 0.12 |
| Total milk yield | | | 0.26±0.45 | 0.10 |

[1] All estimates obtained in a study of two-year-old goats, the performance of which was followed from birth until completion of first or second lactation at about 2.5 years of age (Constantinou et al., 1985b).

On the basis of these results actual selection is being based, for the time being, on indices combining information on growth and milk production characters only (140-day weight and 90-day milk yield, respectively). Some of these indices are shown in Table 4, along with estimates of the correlation between index and aggregate genetic worth. The latter was defined as $H = 1.0\ A_w + 0.15\ A_m$, where $A_w$ and $A_m$ represent breeding values for 140-day weight and 90-day milk yield respectively. The values 1.0 and 0.15 correspond to relative economic weights of improving 140-day weight and 90-day milk yield by one kg, respectively.

Theoretical expectations of selection response from various combinations of indices for males and females are summarized in Table 5. With current breed averages of about 32 kg for 140-day weight and of about 200 kg for 90-day milk yield, these predictions suggest satisfactory effectiveness of the proposed selection strategies.

## Selection procedures for routine use in practical breeding and selection work

In practical day-to-day breeding and selection work involving farmers and stock-owners it may be necessary to express breeding values in simple terms, so that they can be easily understood. Some of the farmers may be interested to select only for higher milk production, others may prefer to breed animals that grow faster.

TABLE 4

Selection indices and correlations with aggregate genetic worth.

| Selection index[1] | Correlation |
|---|---|
| $I_1 = 0.274\ y_1 + 0.042\ y_2$ | 0.53 |
| $I_2 = 0.273\ y_1 + 0.060\ y_2$ | 0.59[2] |
| $I_{31} = 0.241\ y_1 + 0.018\ y_3$ | 0.36 |
| $I_{32} = 0.239\ y_1 + 0.026\ y_3$ | 0.38 |
| $I_{33} = 0.233\ y_1 + 0.030\ y_3$ | 0.39 |
| $I_4 = 0.245\ y_1 + 0.016\ y_3 + 0.013\ y_4 + 0.016\ y_5$ | 0.40[3] |
| $I_5 = 0.267\ y_1 + 0.022\ y_3 + 0.012\ y_4 + 0.018\ y_5$ | 0.43[3] |

[1]) $y_1$ = Kid weight at 140 days of age; $y_2$ = first lactation milk yield in 90 days after weaning; $y_3$, $y_4$, $y_5$ = dam's, maternal granddam's and paternal granddam's milk yield in 90 days after weaning, respectively. All y's expressed as deviations from respective year-flock averages. The second subscript in $I_{33}$ refers to the number of dam records in milk.

[2]) $I_2$ is based on the assumption that the heritability of first lactation milk yield is 40% higher than that of later lactations.

[3])In $I_4$ the dam is assumed to have one record and each grandame three records; in $I_5$ the dam has 1.7 records and each granddam 3.7 records.

TABLE 5.

Predicted average amount of improvement per year from some index selection strategies for male and female Damascus goats[1])

| Selection index[2] applied to males | females | Annual improvement (kg) in kid weight | in milk yield | Relative economic value of improvement |
|---|---|---|---|---|
| $I_{31}$ | $I_1$ | 0.84 | 2.69 | 0.83 |
| $I_{31}$ | $I_2$ | 0.77 | 4.12 | 0.93 |
| $I_{31}$ | $I_{31}$ | 0.95 | 0.86 | 0.72 |
| $I_5$ | $I_1$ | 0.75 | 3.99 | 0.90 |
| $I_5$ | $I_2$ | 0.68 | 5.42 | 1.00 |
| $I_5$ | $I_{31}$ | 0.86 | 2.15 | 0.79 |
| $I_5$ | $I_5$ | 0.82 | 2.75 | 0.83 |

[1]) Assuming that males and females are retained to produce on average two and four kid crops, corresponding to proportions selected of 0.033 and 0.370 respectively.

[2]) Indices explained in table 4.

A simplified index was therefore developed in recent years and farmers are being educated to understand and implement it, when selecting stock.

The simplified index (I) consists of two subindices, one for milk ($I_m$) and one for kid weight ($I_w$) as follows:

$$I_m = 100 + q\ X_m$$
$$I_w = 100 + 10\ X_w$$

$$\overline{I = 200 + 10\ X_w + q\ X_m}$$

$X_m$ and $X_w$ are breeding value estimates for 90-day yield of the dam and 140-day weight of the kid respectively. They are expressed as deviations from respective year-flock averages after correction for significant environmental effects. Correction is done multiplicatively and concerns the effects of season of birth, dam's lactation number and type of birth in the case of kid weight and the effects of season of kidding and age in the case of milk yield. Up to 4 lactation records of the dam may be considered and the respective increase in the accuracy of breeding value estimation is taken into account by inserting a factor q, in the milk subindex. The factor takes values of 0.72, 1.00, 1.14 and 1.23 when there are 1, 2, 3 or 4 lactation records of the dam available, respectively.

The two subindices have an average of 100 (chosen arbitrarily) and approximate standard deviations of 40 and 50 respectively. The full index has an average of 200 and an approximate standard deviation of 65. This allows easy classification of animals depending on whether they fall within one, two or more standard deviations above average.

**PROBLEMS**

Traits related to milk composition, type and conformation are not included in the index for the time being. However, before selection, all animals are visually inspected by trained officers of the Department of Agriculture and those having obvious problems in external appearance are excluded. Udder conformation is an important criterion for culling does and yearly replacement rates of females in government stations amount to about 30%. Since 1980 records on fat and protein content are routinely collected and are currently being analyzed to study their genetic and phenotypic relationships with other traits.

There are also problems in securing a constant flow of breeding stock to the various levels of the system. Owners

of multiplier flocks sometimes require excessive prices for good stock; some farmers prefer to purchase animals from government stations, on the wrong assumption, that all of them are genetically superior to those found outside; other farmers still select stock among their own or their neighbors due to tradition and because phenotypic performance in small well-managed private flocks may be better than in overcrowded government stations. Additional problems arise from a strong farmer preference, especially in goats, to select for body size and for typical external breed characteristics, rather than pay more attention to production.

In conclusion, the Cyprus experience demonstrates that national breeding plans need to be supported by extension and educational programmes and by demonstration. Production records collected in private flocks can fulfil a dual purpose: form the basis for selection, culling and improved management and feeding; and provide a body of data to demonstrate, in the longer term, the benefits of these policies to the individual farmer.

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# CROSSBREEDING FOR IMPROVING FECUNDITY IN NATIVE SHEEP

A. M. ABOUL-NAGA[1] and M. H. FAHMY[2]

[1] Animal Production Research Institute, Ministry of Agriculture, Dokki, Cairo, Egypt

[2] Research Station, Agriculture Canada, Lennoxville, Quebec, Canada

## ABSTRACT

This review deals with crossbreeding experiments conducted at different research organization in subtropical countries which involved prolific crossed with native breeds of sheep. The Finnsheep and Romanov originated in temperate regions have been intensively used for crossing in Egypt, Israel and Cyprus. Chios and D'man are two prolific breeds originated in subtropical countries and the first has been widely used in crossbreeding in Cyprus, Lebanon, Iraq, Israel, Turkey and Egypt. Crossing prolific with native breeds resulted in an improvement ranging between 29% (Rahmani) to 4% (Assaf) in the crossbreds over the purebred native (Avg. 17.4%). When compared with mid-parent average the crosses were 8% inferior. The increase in performance by crossing with prolific breeds was lower in subtropical countries than in temperate countries. Available results on the performance of other combinations i.e. < 1/2 and > 1/2 prolifics are presented.

## INTRODUCTION

In the dry subtropical regions (e g. near and middle east) the tradition has been to raise sheep under extensive production system. However, with the deterioration of natural pastures and changes in socio-economic conditions which increased demand for meat, other alternative systems such as crop-sheep production and small unit production (small holder) are increasingly playing significant roles. Local sheep breeds in the dry subtropic regions are hardy and well suited for the extensive system but their fecundity is rather limited. A high level of fecundity is needed in intensive systems to improve economic efficiency of sheep production. Improving fecundity in native sheep by intrabreed selection has a very limited success mainly

because the heritability of related traits is low and the lack of long term plans. Crossing among native breeds to capitalize on heterosis had a limited success. With the recent availability of a number of prolific breeds, the possibility of fast improvement in fecundity in native breeds by crossbreeding with such prolific breeds becomes apparent. The objective of this report is to review some of the recent research conducted in subtropical countries in crossing prolific with native breeds.

**Finnsheep**

Finnsheep was the first prolific breed to be introduced in the region. A private breeder in Algeria imported the first shipment in 1969. Other importations to Egypt and Israel (1970), Cyprus (1972), Iraq (1973), Lebanon (1974) and Libya (1979) followed. Large scale crossbreeding experiments with Finnsheep were carried out in Egypt and Israel while those conducted in Cyprus and Lebanon were rather limited in size and scope (Aboul-Naga, 1988).

The study conducted by the Egyptian Ministry of Agriculture involved $F_1$ ewes from Finnsheep with local Rahmani and Ossimi, backcross ewes to the local and backcross ewes mated inter se under an accelerated mating system of lambing each eight months (Aboul-Naga et al. 1988). The crosses were 10% higher than the purebred locals in fertility, the $F_1$ averaging 27% higher in prolificacy and 38% higher in yearly lamb production. The corresponding figures for backcrosses were 10 and 23%, and for backcrosses mated inter se 8 and 18%, respectively. However, when calculating the deviation of the crosses from the appropriate means of the two parental breeds, both first crosses and backcrosses showed negative values in prolificacy (around 10%). Under accelerated lambing system, the crosses produced an average of 1.16 litters per year compared to 1.07 for the local breeds and only 0.78 litters for the Finnsheep. As a result of the accelerated lambing ability of the Finn crosses and the rather poor ability of the pure finnsheep to cope with such system under subtropical conditions, the crosses produced about 11% more lambs per year than the appropriate average of their parental breeds.

In another crossbreeding study conducted in Egypt (Zahed, 1988) the local Rahmani and Ossimi breeds in addition to the Barki were crossed with Finnsheep. The $F_1$ crosses of Rahmani and Ossimi gave similar trend to that reported by Aboul-Naga et al. (1988). The cross of Barki excelled in fertility and yearly lamb production (30 and 53% above pure Barki respectively).

In Israel, the Finnsheep were crossed and backcrossed with both Mutton type Merino (another imported breed) and the local Awassi. The $F_1$ Finn-Awassi ewes were either bred inter se, backcrossed to Finnsheep or crossed with Assaf breed (Goot et al 1984). The first cross Finnsheep x Awassi and the backcross 3/4 Finn 1/4 Awassi, both averaged two lambs per litter and 1.4 litters per year with fertility of 80% or better. Both crosses averaged close to 3 lambs per ewe per year. The Finnsheep x Awassi cross bred inter se and the Assaf cross produced at a lower level, yet compared to the average productivity of local breeds in the region, the performance can be considered satisfactory.

The study conducted in Cyprus, crossing Chios with Finnsheep, also involved accelerated lambing (Cyprus Agriculture Research Institute, 1980). Prolificacy in the cross was 2.88 lambs, 35% higher than in the Chios. Both genetic groups were subjected to a twice per year lambing system but succeeded in producing only 1.2 litters per year.

**Romanov**

The Romanov breed was imported from France by Israel (1975) and Egypt (1982 and 1985). The first importations in both countries were of only males which were crossed with Mutton Merino and Awassi in Israel and with the Rahmani in Egypt. In both countries similar crosses with Finnsheep were available and a comparison between the crosses of the two prolific breeds were made under accelerated lambing systems. The Romanov crosses were generally superior to the Finn crosses in fertility and overall productivity (Table 1). However, little difference (1.6%) was observed between respective crosses of the two prolific breeds in prolificacy in both trials. In Egypt and Israel, the first Romanov cross produced 16.7 and 8.1% more lambs per ewe per year than Finn sheep crosses, respectively (Aboul-Naga, unpublished data and Goot et al. 1979). Both first crosses produced at a level much higher than pure indigenous breeds in the region. The two trials are continuing to evaluate other Romanov crosses vs Finn and locals.

**Chios**

Although the Chios sheep have been recognized as one of the prolific subtropical breeds for at least three decades, their importance for improving sheep production in the subtropics became apparent only recently when the other prolific breeds from temperate areas (Finnsheep and Romanov) failed to adapt adequately (as pure breeds) to the conditions of the subtropical countries.

TABLE 1

Contemporary comparisons between Romanov (R) and Finnsheep (F) crosses under accelerated lambing systems in two Near East countries.

| | with Awassi+ | | | with Rahmani++ | | |
|---|---|---|---|---|---|---|
| | R | F | R-F/F% | R | F | R-F/F% |
| Lambs born/ewe exposed | 1.86 | 1.54 | 20.8 | 1.31 | 1.12 | 17.0 |
| Lambs born/ewe lambing | 1.96 | 1.93 | 1.6 | 1.57 | 1.51 | 4.0 |
| No of lambing/year | 1.43 | 1.35 | 5.9 | 1.25 | 1.11 | 12.6 |
| Lambs born/ewe exposed/year | 2.81 | 2.60 | 8.1 | 1.96 | 1.68 | 16.7 |

+ Goot et al. (1979)
++ Aboul-Naga (unpublished results)

Cyprus was the first country to import Chios sheep from its home island of Chios, Greece in 1954 followed by other large importation, (Lysandrides, 1981). In Cyprus, the Chios are raised pure and also crossed with Cyprus Fat-tailed sheep (CFT), Awassi and on a smaller scale with Finnsheep and East Friesian. Chios sheep were imported into Israel, Lebanon, Turkey, Oman, Iraq and Egypt to cross with indigenous breeds. Most of these importations took place recently and the results on the crossbreeding with Chios have just started to appear in the literature (Table 2).

A comparison between Chios and Cyprus fat tailed sheep was reported in 1974 (Cyprus Agriculture Research Institute). The Chios exceeded the native breed by 10% in fertility, 48% and 40% in number of lambs born and weaned per ewe exposed, respectively. Mavrogenises (1985) reported on a crossbreeding experiment between Chios and Awassi sheep in Cyprus. The two reciprocal $F_1$ exceeded the Awassi by 14 and 18% in prolificacy and 13 and 22% in lamb production at birth and weaning, respectively. However, when compared with mid-parent averages, the crosses were lower (-11 % at birth and -5 % at weaning) in prolificacy and lamb production at birth (-1.6%) and only lamb production at weaning was little heavier (7.1%).

Chios sheep were crossed with Awassi in Lebanon (Fox et al. 1977). Fertility of both Chios and Awassi was high and similar in the two breeds. $F_1$ ewes averaged 1.42 lambs, 38% more per ewe exposed than the Awassi but 20% less than the pure Chios (1% more than mid-parent average). The performance of $F_2$ was close to that of pure Awassi. Chios had 60% multiple births compared to 36% for $F_1$ and 14% for

Awassi. Lamb mortality in the Chios was higher, however, than in Awassi (25 vs 12%).

TABLE 2

Reproductive Performance of Chios sheep and their crosses in the Near East.

| Country | Native breed | Trait | Native | $F_1$ | Chios | Reference |
|---|---|---|---|---|---|---|
| Cyprus | CFT | EL/EE* | 0.78 | | 0.86 | (CARI 1974) |
| | | LB/EE | 0.89 | | 1.32 | |
| | | LW/EE | 0.83 | | 1.16 | |
| | Awassi | LB/EL | 1.07 | 1.28 | 1.69 | (Mavrogenises |
| | | LW/EL | 1.03 | 1.27 | 1.54 | 1985) |
| | Finn | LB/EL/yr | 2.88 | 2.13 | 1.89 | (CARI 1980) |
| | | LW/EE/yr | 2.88 | 1.00 | 1.59 | |
| Lebanon | Awassi | EL/EE | 0.95 | 0.95 | 0.93 | (Fox et al |
| | | LB/EE | 1.60 | 1.68 | 1.96 | 1977) |
| | | MB% | 14.0 | 36.5 | 60.0 | |
| Israel | Assaf. | EL/EE | 0.95 | | 0.97 | (Eyal et al |
| | | LB/EL | 1.69 | 1.75 | 2.10 | 1986) |
| | | LM | 10.1 | 12.2 | 10.2 | |
| | | LIN | 294 | 293 | 304 | |
| Turkey | Karayka | LB/EE | 0.83 | 0.91 | | (Ariturk et al |
| | | LB/EL | 1.09 | 1.30 | | 1987) |
| Oman | Awassi | EL/EE | 0.86 | | 1.0 | (Steele 1983) |
| | | LB/EL | 1.44 | | 1.83 | |
| Iraq | Awassi | LB/EL | 1.01 | 1.30 | 1.46 | (Badawi et al |
| | | LM | 16.8 | 7.1 | 13.3 | 1983) |
| Egypt | Ossimi | EL/EE | 0.90 | | 0.90 | (Aboul-Naga, |
| | | LB/EL | 0.95 | | 1.77 | (Unbuplished |
| | | LB/EL | 1.05 | | 1.96 | data) |
| | | LM | 8.0 | 6.7 | 12.6m | |

* EL : ewe lambed, EE: ewe exposed, LB : lambs born, LW : lambs weaned, MB : multiple births, LM : lamb mortality,
LIN : lambing interval in days

Results on crossing Chios with Awassi sheep were reported in Iraq (Badawi et al. 1983). The $F_1$ ewes exceeded the Awassi in litter size by 30% and exceeded the average of the two pure breeds by 5%. Lamb mortality at birth was similar in Awassi and $F_1$ ewes at 7% which was close to half that of Chios at 13%. The percentage of lambs weaned of those born was 87% for crossbreds, 83% for Awassi and only 30% for pure Chios.

Chios sheep were also crossed with Awassi in Oman (Steele, 1983). No results on the performance of the crosses compared to the purebreds are yet available. The Chios showed a superiority over Awassi in fertility (100 vs 86%) and prolificacy (1.83 vs 1.44).

In Israel, the Chios sheep were crossed with the Assaf breed which is itself a cross between East Friesian and Awassi (Eyal et al 1986). The Chios-Assaf crossbred ewes averaged 1.75 lambs (per ewe lambing), 12% lamb mortality, 1.71 lambs and 10% for the Assaf. The authors reported an advantage of 33 and 24% in favour of Chios over the Assaf in prolificacy of yearling and older ewes, respectively. On the other hand, the Assaf exceeded the Chios and the cross in milk production.

In Turkey, the chios and Ile de France breeds were crosses with the Karayka sheep native to Turkey. The Chios cross had 8% better fertility and 19% better prolificacy than the Ile de France cross (Ariturk et al. 1987).

The Chios sheep were also imported into Egypt and crossed with the native Ossimi breed. Both pure breeds had a high fertility of 90%, but the Chios was more prolific than the Ossimi (1.96 vs 1.05 lambs, Aboul-Naga, unpublished data). Information on the reproductive performance of the crosses as compared to the pure breeds is not yet available.

**The D'man Sheep**

The D'man breed originated in an oasis south of the Atlas Mountain in Morocco was reported to be highly prolific with short lambing interval (Lahlou-Kassi and Marie, 1985). So far, it is the only breed originating from arid regions to be recognized as prolific. Its importance is that the sheep are adapted to the harsh and adverse conditions of the region.

Unfortunately, none of the countries in the Near East has imported the D'man, thus all the information on the D'man and its crosses with other breeds come only from its native country, Morocco, and the adaptability and performance of the breed under other environments has yet to be tested.

A crossbreeding experiment with the Sardi Mountain breed was conducted under accelerated lambing system of four lambings in 30 months (Lahlou-Kassi et al. 1988). The crossbred ewes had 41% more ova at 10 months and 76% more at 20 months than the pure Sardi, however, when compared with mid-parent average the cross was 4 and 13% inferior at the two ages, respectively. Prolificacy in the cross was 22 and

69% higher than the Sardi but -2 and 11% higher than mid-parent average, for the two ages, respectively. In other Moroccan studies involving the D'man and Timahadit breeds, the $F_1$ cross produced 14% more lambs born per ewe than the pure Timahadit under a one lambing per year system (Hassan II, 1981) however, when subjected to an accelerated lambing system in a second experiment, the $F_1$ cross produced 24% more lambs than the Timahadit but 9% less than the average of the two parental breeds.

**Other prolific breeds with possible use in subtropical regions**

East Friesian sheep were imported into Israel and Cyprus and crossed with Awassi and Chios, respectively, in an attempt to improve both reproduction and milk yield. (Eyal et al., 1974) reported that the annual lambing rate averaged 1.23 for Awassi compared to 2.20 for East Friesian x Awassi in ewes on accelerated lambing management and hormone treatment.

Mason (1967) reported on other prolific breeds of sheep originating in the subtropics which included the Omani sheep of Oman, the Hy-Yang of China and Svanka of USSR. No information is available on these breeds, and their importance seems to be of local nature. So far none of these breeds was examined under other environments or was crossed with other breeds.

The Barbados Blackbelly originated in Barbados and is presently available in many Central American countries, and in USA is another prolific breed with many potentials for the subtropics. Litter size was reported at 2.0 lambs in Barbados (Patterson, 1976). In over 1000 litters, 26% were singles, 47% twin and 22% triplets. In USA the Barbados were crossed with Dorset, Rambouillet and Targhee (Bradford and Quirke, 1986). The crosses performed at higher levels than the pure American breeds. However, the use of Barbados sheep in crossbreeding with native Near East breeds is not foreseen in the near future.

The discovery of the major fecundity gene (F) in the Booroola Merino, and possibly in other breeds, may add new dimension in improving fecundity in sheep breeds, including those in the subtropics. Crossbreeding to introduce the fecundity gene then backcross to the native breed to capitalize on the super adaptability of the latter while maintaining the gene (F) may become an alternative method to increase fecundity in subtropical breeds.

## DISCUSSION

The use of prolific breeds of sheep and their introduction into many countries to improve the prolificacy of native sheep produced information on the performance of different crosses of prolific x native sheep. An intensive review of experiments conducted in temperate countries was published by Jakubec (1977) and for those involving only Finnsheep, by Maijala (1984). Table 3 presents the superiority of first

**TABLE 3**

Superiority of $F_1$ ewes over native and mid-parent in temperate and subtropical countries.

| Native x Prolific | Native mean | % over native | % over mid-parent | Reference |
|---|---|---|---|---|
| A: Temperate | | | | |
| Mutton Merino x Finn | 1.34 | 29.1 | -1.7 | after Jakubec (1977). |
| Mutton Merino x Rom. | 1.34 | 36.6 | 0 | |
| Berrichon x Rom. | 1.27 | 50.4 | 3.8 | |
| Roma x Berrichon | 1.27 | 44.0 | 0 | |
| Ile de France x Rom. | 1.63 | 33.1 | --- | |
| Galway x Finn. | 1.40 | 42.8 | 2.6 | |
| Blackhead x Finn. | 1.56 | 35.9 | 7.6 | |
| Merino L x Finn. | 1.23 | 49.6 | --- | |
| Blackhead x Finn | 1.41 | 56.7 | --- | |
| Ile de France x Finn. | 1.86 | 40.0 | 5.2 | Visscher (1986). |
| 3 US breeds x Finn. | 1.19 | 39.5 | -1.8 | Oltenacu and Boylan |
| DLS x Finn. | 1.44 | 47.2 | -1.4 | Fahmy and Dafour (1988). |
| Unweighted means | | 40.7 | 1.6 | |
| B. Subtropics | | | | |
| Rahmani x Finn. | 1.31 | 28.2 | -10.2 | Aboul-Naga et al. (1988). |
| Ossimi X Finn. | 1.22 | 24.6 | -16.7 | |
| Awassi x Finn. | 1.00 | 30.0 | ---- | Goot et al.(1976). |
| Assaf x Chios | 1.69 | 3.6 | - 7.6 | Eyal et al.(1986). |
| Awassi x Chios | 1.01 | 28.7 | 5.3 | Badawi et al.(1963). |
| Awassi X Chios | 1.03 | 37.8 | 0 | Fox et al. (1977). |
| Awassi x Chios | 1.07 | 14.5 | -11.2 | Mavrogenises (1985). |
| Unweighted means | | 23.9 | -6.5 | |

cross over the native breed and its deviation from mid-parent average in temperate and subtropical regions. It can be observed that in all the studies the cross average exceeded that of the native breed by as much as 57% in temperate and 38% in subtropical regions. The average superiority of the cross was 41% for temperate but only 24% for subtropical regions. The corresponding estimate for the deviation of the cross from mid-parent were 1.6 and -6.5% respectively.

The performance of the crosses in subtropical regions was markedly lower than that expected assuming additive gene action. The review of Maijala (1984) and the study of Fahmy and Dufour (1988) indicated that ovulation rate and subsequently litter size increase almost linearly with increase in Finnsheep breeding and that these characters showed small, or no heterosis at all. With limited studies available from subtropical region on ovulation rate or embryonic mortality it is difficult to speculate whether the lower prolific performance in prolificacy of the crosses is a result of lower ovulation, limited uterine capacity or higher embryonic mortality. Lahlou-Kassi and Marie (1985) stated that D'man breed does not seem to possess a greater uterine capacity than other non-prolific breeds and that embryonic survival was low, 72% for monoparous and 59% for multiparous D'man ewes.

In most subtropical countries, the introduction of prolific breeds was to develop composites suitable for the prevailing conditions. The tendency has been to reduce the prolific proportion to no more than fourth. Most of the studies on these composites are still going on, preliminary results indicate that the composites are well adapted to local conditions and produce higher than pure local breeds.

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# POTENTIAL SHEEP AND GOAT BREEDS IN THE NEAR EAST

R. A. GUIRGIS

Desert Research Institute, Matareya, Cairo, Egypt.

## ABSTRACT

Sheep and goats are important animal resources in the Near East. Potential breeds of sheep and goats, outstanding in different productive traits, in the Near East, may be considered useful improver candidates to provide genetic material in improvement programmes in the region. Some potential breeds are reviewed on account of the type of productivity of which they are superior. These are dairy, prolific and speciality fibre-producing breeds. The utilization of potential genetic resources is discussed.

## INTRODUCTION

Sheep and goats are important animal resources throughout the Near East, where about 313 million head of sheep and goats, representing 19.6 % of the total world population, are raised.

This presentation will discuss some of sheep and goat breeds distinct in their production potential. It is suggested to use these genetic resources for improving productivity in the Near East region instead of importing exotic breeds that might not adapt to the environmental conditions of the region.

## POTENTIAL SHEEP BREEDS

Examples of potential breeds are given as classified by their type of production.

### 1) Dairy breeds of sheep

Few breeds can be considered as dairy breeds on account of their high milk production.

a) Awassi

Awassi is a fat-tailed breed widespread throughout the Near East. The greatest number is in Iraq, it is the most important sheep in Syria and the only indigenous breed of sheep in Lebanon, Jordan and Israel. Mason (1967) reviewed the weight of unimproved adult Awassi rams throughout the range of the breed which varied between 60 and 90 kg, and those of ewes between 30 and 50 kg,

Awassi sheep have a high potential for milk production. Guirgis et al., (1980) recorded values of total milk yield of 139.8 kg, during a lactation period of 183 days, and 155.7 kg, during a lactation period of 167 days, in two suckling regimes in Iraqi Awassi sheep.

In an experimental Awassi flock in Lebanon, the average milk yield in six consecutive lactations, ranged from 268 to 406 kg. High yielding Syrian Awassi recorded 160-180 kg. In Turkey, average lactation yields of Awassi sheep varied between 100 and 185 kg, record ewes yielding as much as 390 kg (Epstein, 1987).

Very high yields have been reported in Israel, where Awassi has been selected for milk. In many flocks (Epstein 1987), average milk yields exceed 400 kg. The milk of Awassi ewes contain an average 7.5% fat (Mason, 1967).

The Awassi grow long coarse wool with an open moderately lustrous highly medullated fleece of carpet wool type.

b) Chios

Chios is a semi-fat tailed breed that originated from the Greek island of Chios. Chios sheep are characterized by early sexual maturity. It has a long breeding season which is favourable for multiple lambing per unit of time (Osman, 1987). Prolificacy, lambs born per ewe lambing, at government stations in Cyprus, was 1.70. Chios wool is medium to coarse in quality, the greasy fleece weights average 1.4 and 2.0 kg for ewes and rams, respectively (Lysandrides, 1987).

The Chios sheep combines in it the highly desirable traits of prolificacy and high milk yield, but it requires good feeding and high standard of management to attain its potential. The total milk yield is about 240-280 kg in a lactation period of 212-220 days (Louca, 1972).

In Lebanon, the Awassi was crossed with the Chios breed to improve fertility (Fox et al., 1971). Results indicated a

degree of heterosis of about 0.24 lambs born per ewe joined.

**2) Prolific breeds of sheep**

**D'man**

The D'man is a thin-tailed, coarse-woolled, very prolific and early mature breed of sheep bred in Morocco. It is considered one of the few remarkable breeds in the world that will reach puberty at about six months of age and lamb twice a year, with a high incidence of multiple births.

The breed is reported to lamb all the year round. Mean performance was reported as follows : fertility 93 and 94 percent for adults and yearling ewes respectively; lambing interval 192 days; age at first lambing, 420 days, annual lambs weaned, 213 and 169 percent for adult and yearling ewes respectively; and liveweight at 180 days, 33.5 kg (Mason, 1977).

In a crossbreeding programme, in Morocco at the age of 10 to 11 months, the conception rate was 91 percent and prolificacy 130 percent in the D'man X Sardi ewe and 61 & 107 percent, respectively in the local Sardi ewe (Lahlou-Kassi, 1987).

Lahlou-Kassi (1987) reported values of 6-8 months, 11-17 months, 71-100 percent, 146-224 percent and 185-240 days, for age at puberty, age at first lambing, fertility, prolificacy and lambing interval, respectively, in the D'man sheep breed.

**3) Carpet wool breeds**

There are more than 40 indigenous breeds of sheep in the Near East, which vary in their fleece types. Some have carpet wool, while many others are hair sheep with no wool.

The wool grown by carpet wool sheep consists of a long, hairy, outer coat which protects a fine undercoat of true wool. This type of fleece protects the sheep from low temperatures, high winds and variations in moisture, ranging from extreme dryness to excessive rain.

a) Karaman: About 40 percent of the sheep in Turkey are of the fat-tailed Karaman breed, the most widespread variant of which is the Akkaraman, which produces a white fleece containing many grey fibres. Only about a quarter of the fibres in Akkaraman staples are non-medullated. Batu & Ozcan (1962) reported values of 5.6, 14.8-79.3 um and 31.9 um, for S/P ratio, fibre diameter range and mean fibre diameter of Akkaraman sheep. The fleece weighs 1.2-1.9 kg.

b) Baluchi : The Baluchi is the most widely distributed breed in Iran, accounting for 50 percent of the sheep population. It is also found in Pakistan and Afghanistan. It is a fat-tailed, fairly small breed with a live weight of 40-50 kg. Average greasy fleece weight 1.3-1.8 kg, diameter 30 um and percent medullation 28.

c) Kurdi : Kurdi is a fat-tailed breed raised in Iraq, Iran and Turkey. Rams average 78-80 kg and that of ewes 50-60 kg. Staple length is 15-20 cm. Estimates are 2.3-3.0 kg, 47.0 Um and 3.9 for greasy fleece weight, average fibre diameter and percent medullation, respectively.

D) Lohi : Lohi is the most numerous and productive indigenous breed of sheep in Pakistan, accounting for 25% of the population. It is a large thin-tailed multipurpose breed. Ewes are good milkers. Lohi sheep produce very coarse fleece, with an average greasy weight of 1.8 kg and a staple length of 9-10 cm.

E) Karakul : Karakul is a fat-tailed breed that produces carpet wool. It is kept primarily for the production of lambskins for fur, considered as an important animal industry in Afghanistan. It is also bred in Iran and Turkey. The fleece colour is black, reddish brown, grey and white. Fleece estimates are 2.0-2.6 kg, 38 um and 57 for greasy fleece weight, average fibre diameter and percent medullation, respectively.

Carpet production is one of the most important end-uses of wool. The Near East region is a high quality carpet wool producer which is in high demand on the world market.

Carpet yarn is not spun from a single wool type. Yarn manufacturers usually combine various wools into a blend, which turns out to be a compromise to try to satisfy partially all the requirements.

There are three categories of wools used in the ratio of a blend which is determined by availability, the characteristics required in the completed carpet and price :

1) Speciality carpet wool, which are usually highly medullated and are frequently very bulky.

2) Basic or general purpose wool, of good colour, strength and spinnability as coarse crossbred fleeces.

3) Filler wools are usually short and tender as crutchings, pieces, bellies and poor oddments.

Ross (1978) reported values of 10-20, 30-60 and 50-30 percent of the blend as speciality carpet wool, fleece wool and crutchings and pieces for woollen and semi-worsted carpet yarn spinning, respectively. Ross (1978) showed that wide variability in fibre diameter is associated with a crimpy short fine undercoat and coarse medullated outercoat fibres. These types are considered desirable; the finer fibres help spinning and yarn bulk, the coarse fibres give the desired handle and appearance. A reasonably wide range of fibre diameter variability is desirable in the woollen system and for woven carpets.

In general fibre length is of much more concern to the manufacturer in carpet wools than mean fibre diameter.

A proportion of medullated wools is desirable in a carpet blend, the actual proportion depending on the processing system and the particular product being made. The percentage of medullated fibres in wools differs enormously as does medulla-to-cortex ratio. The function of medulla in the carpet pile is not clear but many manufacturers believe that the inclusion of medullated wool enables the pile yarn to cover the backing satisfactorily without the need of a great weight of pile fibres (Turner and Dunlop, 1974). Wickham (1978) explained that medullation in speciality carpet wools appear to be associated with resilience which allows recovery of the pile following treading. Resilience and the ability to withstand hard wear are the two special requirements for carpet wool. Medullation is also thought to be associated with resistance of carpets to soiling. However, too much medullated wool in a carpet blend can result in an unacceptably high wear rates.

Ross (1978) summarized specifications which could be expected to bring a price premium. To a carpet mill : Staple length about 10 Cm; fibre diameter, high preferably 36 um or more; medullation, as medullated as possible provided fibre strength and elasticity are satisfactory; no kemps; reasonably sound; high spinnability; high settability; helical crimp as high as possible for bulk and resilience; free from vegetable matter and other contaminants; maximum fleece openness, with no cots. To the farmer : high fleece weight, high fertility of the sheep and consistent acceptable price premium.

In order to obtain these specifications, geneticists should be consulted to see the possibility of putting all these desirable characteristics together in the wool of one sheep.

In carpet wool breeds, increasing fleece weight should be the main selection objective. In Drysdale sheep, a speciality carpet wool breed in New Zealand, the main selection traits are the number of lambs born (or reared) per lambing, fleece weight and fleece grade.

Increasing wool production based on greasy fleece weight through increased fleece density is undesirable in hot humid climates, which affects thermoregulatory mechanisms and encourages the faulty canary yellowing. Selection for increased fibre length would be more logical (Burns, 1986). Heritabilities and repeatabilities of fibre length range from medium to high.

The use of mobile electric shearing machines and an integrated marketing system, that comprises, harvesting, clip preparation and packaging, should be aimed at. Clip preparation involves skirting and classing, the main objective of the latter is to produce separate lines of wool sufficiently uniform for subjective evaluation. Skirting is concerned with the removal of faulty pieces and areas of atypical wool (bellies, locks, stains) from the main fleece which are likely to affect processing.

Guirgis (1979) and Guirgis et al., (1979) demonstrated the possibility of selection of some carpet wool characteristics, in the adult fleece at an early age of one month at the birthcoat level.

## POTENTIAL GOAT BREEDS

Goats are kept in large numbers in the Near East, few breeds of which are outstanding, with valuable genetic potential in the following production lines :

### 1) Dairy breeds

#### a) Damascus

Originated in Syria and has spread to different countries in the Near East. The Damascus goat has a coat, mostly of long hair, reddish brown in colour. Adult weights are from 55 to 65 kg and from 70 to 90 kg, in does and bucks, respectively. Both male and female kids are used for breeding during their first year of life. Conception rate at first mating is about 80 percent. Litter size values are 1.68 and 1.50 for those alive at birth and at weaning respectively and that weight at weaning is 27.0 kg (Constantinou, 1987).

The Damascus goat is characterized by high milk yields (500-600 kg/ goat) and high prolificacy (1.75 to 2.25 kids/goat). When adequately fed, it matures early and breeds at the age of 8 to 10 months (Economides, 1987).

Aboul-Naga et al., (1985) crossed Damascus bucks with desert Barki goats, in Egypt. The crossbred 1/2 Damascus 1/2 Barki had 25 percent higher milk production than that of the local desert Barki goats. Crossbred kids excelled local Barki kids by 19.7, 26.6, 9.9 and 18.9 in birth weight, viability, weaning weight and yearling weight, respectively.

In Egypt, milk yield at first lactation averaged 142 kg during a lactation period of 25 weeks (Galal, 1987).

In Cyprus, during the last few decades, Damascus goats have been used to upgrade the native stock (Constantinou, 1987).

b) Nubian

This breed is found in Sudan and is widespread in North-East Africa and the Mediterranean coastal belt. Egyptian Nubian, known as Zaraibi, is reported to be the main progenitor of the Anglo-Nubian breed.

The Nubian is a large, long-legged goat with long pendulous ears and a pronounced roman nose. Colours vary, some are black while others are brown and the coat is long.

Mature Zaraibi weights average 35-70 and 25-40 kg for males and females, respectively. Average milk yield 87 kg in 19 weeks with butterfat percentage from 2.36 to 3.87. Number of kids born per doe kidding 1.45 to 1.55, age at first kidding 18.8 months and does breed all the year round (Galal, 1987).

Devendra and Burns (1983) believe that the genetic potential of the Nubian breed may be greater than has yet been established. They recommended a large scale improvement project through selection starting with a survey of various strains to develop an outstanding African dairy breed. This would necessitate cooperation between neighboring countries.

In Tunisia, the Nubian breed forms 10 percent of the total population. Mahjoub et al. (1987) reported first mating at 18 months, kidding interval 8 months, fleece weight of 0.3 and 0.6 kg of females and males, respectively, and that average milk yield was 250 kg.

Said (1983) showed that most of the kiddings (78%) occurred from October to February and reported a milk yield of 55.47 kg during a lactation period of 13 weeks, in Zaraibi goats in Egypt.

c) Beetal

It is an important breed extensively distributed in west Pakistan, usually red in colour with white spots. Adult does weigh about 45 kg.

It has an average milk yield of 195 kg during a lactation period of 224 days. However, the breed possesses high potentiality in milk yield (Devendra and Burns, 1983).

d) Barbari

The breed is short haired, variable in colour with commonly white and tan spots and is raised in west Pakistan. Adult does have an average weight of 27-34 kg. The Barbari, though small in size, produces a considerable amount of milk, which makes it an economical producer.

There are indications that Barbari is a dual purpose milk and meat breed. It is very prolific, does commonly give birth to twins and triplets and that they usually have three kiddings in two years. Devendra and Burns (1983) recommended special attention to be given to Barbari goats and their use in improvement programmes in other tropical countries.

**2) Prolific breeds :**

Black Bengal

Besides Barbari, the Black Bengal breed is known for its high prolificacy. It is widely distributed in the northern part of East Pakistan. Its economic importance rises from its production of high quality, tender and tasty meat and skins of considerable demand in high quality shoes making.

Black Bengal is short legged, usually black in colour with adult weights ranging from 28 to 34 kg. Twins and multiple births are commonly encountered with an average value of 2.05 kids/doe kidding (Moulick et al., 1966).

3) **Speciality fibre producing breeds :**

a) Angora goats

Raising of Angora goats, originated in the region of Angora on the Anatolian plain in Turkey has spread into many countries as South Africa, U.S.A., Australia, Pakistan and New Zealand.

The primary product of Angora goat is mohair, a valued textile fibre. The hair grows in long white lustrous locks of ringlets to a length of 1 up to 25 cm and that in Turkey, goats or shorn annually. Yalcin (1983) reported average values for yearling females and breeding does of 1.49 and 2.96 kg, for greasy fleece weight, 1.08 and 2.11 kg for clean fleece weight, 15.6 and 16.4 cm for staple length and 26.0 and 35.8 um for fibre diameter, respectively.

Out of a world mohair production a of 18.4 million kg in 1985, Turkey contributed 3.5 million kg. Mohair is used in a wide range of products indicating a good potential for increased demand. The elasticity of mohair coupled with its excellent blending qualities explains its superior use in knitting yarns.

Yalcin (1983) reported that selection for fleece and body traits in Angora can be based on the yearling record, repeatability values for body weight greasy and clean fleece weights, fibre diameter and yield are high (from 040 to 0.72). However, low heritabilities of the same traits (from 0.12 to 0.24), apart from mohair yield ($h^2$ =0.43), were encountered, indicating the major role of environment, especially feeding and management, in possible improvements.

Yalcin et al. (1979) reported a positive genetic correlation of S/P follicle ratio with clean fleece weight (r = 0.33) and a strong negative correlation with fibre diameter (r = 0.84). They recommended the use of S/P ratio, at 5 months of age, as an indirect aid to early selection of fibre fineness and that would lead to improvement in clean fleece weight.

Angora goats have been used in crossbreeding with indigenous long-haired goats, in Pakistan and India to develop mohair production.

b) Cashmere goats

Cashmere is an animal fibre produced by goats, kept at high altitudes in Iran, Turkey, Afghanistan and Iraq. The main characteristic of cashmere goats is that the undercoat

is well developed, which makes the fine, soft material sold as "Pashm" or "Pashmina" of most commercial use for clothing.

The undercoat, down, is not usually clipped from the animal but is shed naturally every spring (about June) where it is gathered up or combed out.

The colour of cashmere is white, and from fawn to grey, the naturally coloured fibres being more common than the white. The average diameter is usually about 15 um with a C.V. of fibre diameter of 18-20%. The fibres are 2.5-9.0 cm in length. Many fibres are pigmented.

In Iran cashmere goats are shorn in spring and contains colours of white, grey, dark, brown, black and fawn. Iranian cashmere has an average down content of 74 percent and 26 percent hair, The average diameter is between 17.5 and 19.5 um. That from Turkey and Afghanistan is slightly finer.

## UTILIZATION OF POTENTIAL GENETIC RESOURCES

To encourage exploitation and the best utilization of potential breeds, the following points are suggested :

1. Documentation of all aspects of performance of potential breeds in their local environment.

2. Evaluation of these superior breeds, under economically feasible management conditions which includes phenotypic characteristics, an economic evaluation of productive traits, genetic parameters as heritability, repeatability and genetic correlations for different traits, and estimation of combining ability of potential breeds with local breeds. Demiruren (1987) demonstrated a potential increase, of production of indigenous sheep in the eastern Mediterranean region based on husbandry. By applying improved feeding and management systems it would be possible to have a potential increase of 33, 32 and 69 percent in mutton and lamb, milk and greasy wool production.

3. Establishment of breeding stud flocks to produce superior sires, for distribution to flock owners.

4. The use of potential breeds of the Near East region to improve productivity of the local stock of the region. High fecundity is a valuable and precious genetic resource. The D'man breed of Morocco, known for its

high litter size and early maturity, should be extensively used in raising the fertility of indigenous sheep in the region.

Steinbach (1987) advocates the storage of potential breeds in reservoir flocks on a regional basis under the auspices of some regional organizations as ACSAD, Arab Center for the study of Arid Zones and Dry lands, and ICARDA, International Center for Agricultural Research in the Dry Areas, which would be made available for breeding purposes throughout the region.

Well organized research programmes coordinated through regional, and international organizations, would expand the contribution of potential breeds of the Near East on an intra-regional basis.

Morag (1972) suggested the use of the stratification system in the Near East, containing three different strata:

The base population on the range (first stratum) would be a hardy breed as the Awassi. Some of the ewes would be mated with dairy breeds (Chios) to produce crosses for stratum (2) for milk production. Crossbred ewes would be mated to mutton rams and crossbreds transferred to stratum (3) for fattening.

Some of the potential sheep breeds in the Near-East produce high quality carpet wool, in high demand on world markets, which necessitates the preservation and improving productivity of carpet wool breeds. Turner (1987) postulated a 20 percent increase in clean wool weight in 10 years, through selection.

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# POTENTIAL OF DUAL PURPOSE GOATS

C. F. GALL

University of Hohenheim, FRG
Center for Agriculture in the Tropics and Subtropics
Institute for Animal Production

## ABSTRACT

Dual purpose production with dairy goats is aimed at utilizing the potential for producing meat mainly by feeding surplus kids. Feeding of milk is economically critical because of high milk price, low price for slaughter animals and poor feed conversion. The cost of producing kids may be reduced by high reproductive rate; it can be increased mainly by measures of management (choice of kidding season, feeding). The quantity of milk deviated from sales may be reduced by early weaning and restricted suckling. Both practices do not impair milk yield and kid development. General nutritional principles apply to post-weaning feeding. Growth rate and carcass composition can to a very limited extent be influenced by selection, but they depend mainly on management. Analyses of dual purpose production systems are needed which would furnish the elements for optimizing resource allocation between milk and meat production.

## Dual purpose milk and meat production systems

The term dual purpose is widely used in goat production (as it is in cattle production) to designate production of meat from animals mainly kept for dairy purpose or also the production of milk from animals mainly kept for meat. Since the combination of meat and fibre production has little importance in the Near East, the present discussion will be limited to milk and meat production. Which of the two is the primary production depends on the feed resources available and on the relation between milk and meat price. In the Near East almost always milk is the primary product with goats. Dual purpose milk and meat production with goats is mainly achieved by using the potential for meat production of the progeny which is not needed for breeding. All the males born may even be used for meat and some of them will serve as sires prior to being slaughtered. It is very uncommon that

surplus kids are not raised for meat but destroyed at birth although an economic evaluation would justify this practice under certain circumstances. In theory, the slaughter value of cull goats adds to the meat production component. Again, it is very rare that culls are not used for meat. In fact, there are no systems in which no use is made at all of the meat producing potential of dairy goats. Therefore, the term dual purpose production apparently needs to be more precisely defined. Tentatively I suggest the following definition for dual purpose production:
"a system in which some benefit by the primary line of production is sacrificed for improving the secondary production with the expectation that overall efficiency of the system is thereby increased. This effect may also be partly or completely a reduction of risk".

In a dual purpose breed some of the selection potential would then be dedicated to improve the secondary production, albeit at the expense of not fully realizing the potential for increasing the primary production or even reducing it.

The decision of herd management to use some of the milk produced for feeding kids depends on the efficiency of converting it to meat. In a first approximation the ratio

$$v = \frac{\text{liveweight gain} * \text{liveweight price}}{\text{milk consumption} * \text{milk price}}$$

equal to price relation milk/liveweight : feed conversion, gives an indication whether or not feeding of milk to kids is economical. if v is smaller than 1, milk is more economically used by selling than by feeding to kids. In the following table it can be seen that the liveweight price must be at least six times the milk price for milk feeding to be justified, even at the highest feed conversion rates.

For a more exact evaluation of possible profits from fattening, additional costs (veterinary care, supplementary feeding, marketing), the value of the kid after having consumed the (non marketable) colostrum and kid losses during the fattening period have to be considered as well as the possibility of adding value to the weaned kid by further feeding it to higher weights on other feeds than milk. With restricted suckling (milking and suckling combined) it has to be considered furthermore that the quantity of milk obtained by milking is reduced with increasing length of suckling (Zygoyiannis, 1987).

Economic data on kid meat production are not available for Near Eastern countries. For Swiss conditions a gross margin

TABLE 1

Efficiency of milk feeding (v) as function of feed conversion and price relation.

| Feed conversion | relation liveweight price : milk price | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 20.0 | 18.0 | 16.0 | 14.0 | 12.0 | 10.0 | 8.0 | 6.0 | 4.0 | 2.0 |
| 6.0 | 3.3 | 3.0 | 2.7 | 2.3 | 2.0 | 1.7 | 1.3 | 1.0 | 0.7 | 0.3 |
| 6.5 | 3.1 | 2.8 | 2.5 | 2.2 | 1.8 | 1.5 | 1.2 | 0.9 | 0.6 | 0.3 |
| 7.0 | 2.9 | 2.6 | 2.3 | 2.0 | 1.7 | 1.4 | 1.1 | 0.9 | 0.6 | 0.3 |
| 7.5 | 2.7 | 2.4 | 2.1 | 1.9 | 1.6 | 1.3 | 1.1 | 0.8 | 0.5 | 0.3 |
| 8.0 | 2.5 | 2.3 | 2.0 | 1.8 | 1.5 | 1.3 | 1.0 | 0.8 | 0.5 | 0.3 |
| 8.5 | 2.4 | 2.1 | 1.9 | 1.6 | 1.4 | 1.2 | 0.9 | 0.7 | 0.5 | 0.2 |
| 9.0 | 2.2 | 2.0 | 1.8 | 1.6 | 1.3 | 1.1 | 0.9 | 0.7 | 0.4 | 0.2 |
| 9.5 | 2.1 | 1.9 | 1.7 | 1.5 | 1.3 | 1.1 | 0.8 | 0.6 | 0.4 | 0.2 |
| 10.0 | 2.0 | 1.8 | 1.6 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 | 0.4 | 0.2 |
| 10.5 | 1.9 | 1.7 | 1.5 | 1.3 | 1.1 | 1.0 | 0.8 | 0.6 | 0.4 | 0.2 |

per kid marketed at 53 days of age of Frs. 36.0 has been calculated (KÜnzler and Schmidlin, 1982). This equals 3½ times the value of the kid at 10 days of age. If milk replacer was used instead of whole milk the margin increased to Frs. 50.0.

Until weaning, kids are fed in addition to milk and grain only insignificant quantities of roughage. Roughage and grazing may not be unlimited available. All of it may be necessary to fully exploit the milk producing potential of the dairy herd, given that the other resources (labour, facilities, supplementary feed, veterinary care) are available. If meat animals are to be fed to an advanced age a decision needs to be taken whether some of the limited feed resources will be diverted from milk to meat production. Again, the decision depends on the efficiency of feed conversion for both lines of production. However, the situation as described rarely exists in the Near East and kids or young goats are fed to the highest weight that the market will accept.

The efficiency of meat production can be increased by

- improving feed conversion,
- increasing growth rate,
- improving carcass value.

These improvements can be achieved through management and through breeding.

Measures of herd management will aim at:

- number of kids weaned,
- milk yield to satisfy needs of kids born,
- quantity of milk given to kids,
- time until weaning,
- intensity of feeding after weaning,
- slaughter age.

Breeding will try to improve:

- reproductive rate,
- size and weight of kids at birth,
- growth rate,
- carcass composition,
- mature weight of goats,
- lactation performance.

**Management**

Management can markedly influence the number of kids weaned as well as the quantity of milk produced. Details of possible procedures shall not be discussed in this paper.

There are basically two methods of raising kids for meat, artificial rearing or suckling. With artificial rearing kids may either be separated from their dams immediately after birth and hand fed colostrum or left to suckle during the colostrum period and separated afterwards. If artificial rearing is possible (availability of milk replacer, facilities and skilled labour) the shortest possible suckling period will be appropriate.

When dams raise their kids these may suckle for the whole milk feeding period and be weaned off their dams; milking may start only after weaning or earlier combining milking and suckling. Length of suckling period will be geared towards striking a balance between the market value of the milk fed and the value of the extra liveweight produced.

The choice between the different procedures depends mainly on does' milk let-down and the level of milk production. Studies with dairy goats have shown that lactation performance is not affected by the suckling stimulus and intensive or extended suckling is not required for realizing milk production potential. As a rough indication, maximum milk requirement of kids is about 10 per cent of their body weight. Thus, if milk yield exceeds this quantity milking is warranted. Moreover, it has been shown that milk intake may be restricted if supplementary feed is available (good quality roughage and compound feed). Thereby development of

the reticulo-rumen is accelerated, intake of feed enhanced and feed conversion improved. Systems of restricted suckling were developed with Damascus goats in Cyprus (Hadjipanayiotou and Louca, 1976). Suckling 8 hours per day was compared with continuous suckling in 44 goats. Seventy day milk yield was 260 and 250 kg, 70 days marketable milk was 144 and 67 kg, weaning weight was 15.8 and 17.7 but 71 to 150 days post-weaning gain was 210 and 190 g per day. Likewise in Cyprus, it was shown that kids could be safely weaned at 7 weeks of age. Restricting suckling may also increase reproductive performance in a system where does are re-bred about 7 weeks post partum (Guimaraes Filho, 1983; Lawson et al., 1984).

Traditionally in dairy goat operations kids are sold as early as the market will accept them. Doubtless this reflects the fact that feed conversion is poor and price relation between liveweight and milk is narrow resulting in a coefficient v far below 1.

**Breeding**

Most goat breeds of the Near East are capable of producing twins if environmental conditions and management are adequate. Little response is to be expected from intra-breed selection (Constantinou and Mavrogenis, 1987). Therefore, selective breeding for increased reproductive rate will not be warranted in most cases. Crossbreeding would have to try and import the genetic disposition for high reproductive rate and for growth. Milk production potential would have to be sufficient to cater for the additional kids' needs. Data from literature indicate that growth rate or weight for age would respond to selection (Mavrogenis et al., 1984). However, growth rate of kids depends largely on mature weight of the breed. There is little information available on the extent of variation in growth rate independent of mature size. If selection for daily weight gain would lead to larger animals at mature age this would be acceptable as long as milk yield would be correlated with size and would increase concomitantly. Furthermore increased size would be acceptable only if the animals could be fed and managed and if they would not be less well adapted. Experience with other species would suggest that not all these expectations are justified. Shelton (1978) has speculated that the goat owes its good adaptation and fertility to the fact that man has not attempted to alter its growth rhythm.

The economic importance of carcass composition is debatable. Most goats are sold outside regulated market channels. Grading of carcasses is an exception kid carcasses are valued for their whitish meat, fat cover and, since they

are sold entire not cut, for the quality of dressing (Morand-Fehr et al., 1980). Carcasses of older goats are graded mainly by the extent of fat deposits. Since this is mainly a function of age and feeding there is little room for genetical improvement. The desirable subcutaneous and muscular fat is probably only 25 % of the total body fat. Increasing total body fat will primarily result in more fat in the body cavities which is little appreciated; only at high and costly degrees of total carcass fat can the external depots be expected to develop. Variation of the proportion of weight of various cuts to the whole carcass weight seems to be mainly caused by differences in fat deposition; it is not apparent in fat free carcass. However, the available data on carcass composition are based on quite different experimental methods and are therefore not readily comparable.

## CONCLUSIONS

Kids born in excess of the number needed for replacements are a potential for meat. Inputs in the form of feed and possibly labour and housing are needed to develop this resource. Milk production competes for these resources. Rational resource allocation requires optimization of resource use. To date this optimization has not been done for goat production systems. So far it has been demonstrated that kids can be raised by nursing does who are milked at the same time. Since milk yield is impaired very little with restricted suckling this seems to be a valid method. Increasing the number of kids and their growth rate may improve efficiency of meat production but the effect of these measures on the overall production system still needs to be assessed. There seems to be little scope for increasing the efficiency of meat production through improved carcass quality.

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# SEASONALITY OF REPRODUCTIVE ACTIVITY IN NATIVE SHEEP AND GOAT BREEDS AND THEIR CROSSES WITH INTRODUCED BREEDS.

M. B. ABOUL-ELA[1] and P. CHEMINEAU[2]

1. Department of Animal Production, Faculty of Agriculture, Mansoura University, El-Mansoura, Egypt.
2. INRA Station de Physiologie de la Reproduction, 37380 Nouzilly, France.

## ABSTRACT

Many local sheep and goat breeds in the Near East can be considered as breeds of long breeding season or a typical non-seasonal breeds. They show cyclic activity throughout most of the year, with period of low activity or anoestrus limited to spring months. Differences in the degree of seasonality, however, are found between breeds raised at the same location or between flocks and individuals of the same breed. Seasonality in oestrous activity is more pronounced than that in ovarian activity, the difference between the two is mainly found during February-July. Seasonality is reported also in ovulation rate and breeding performance with lower figures obtained in spring mating than winter or autumn matings. Changes in daylength, although of small magnitude in the region, affect oestrous and ovarian activities in local sheep breeds with the effect being more pronounced on oestrous than ovarian activity.

Exotic breeds imported into the region, maintained almost similar degree of seasonality as in their countries of origin, which highlights the role of genetic control of seasonality in small ruminant breeds and indicates that such genetic control was not overcome by the changes in environmental conditions. There is evidence of heterosis in the cycling activity of crosses between local and imported breeds, which is more pronounced during periods of lower activity (February-July).

Seasonality in semen characteristics and libido of rams and bucks in different local and imported breeds and their crosses is generally less defined and less consistent than seasonality in female reproductive activity.

## INTRODUCTION

Local sheep and goat breeds of high and medium latitudes (>40°) present marked seasonality of reproduction both in females (Hafez, 1952, Chemineau et al., 1987) and males (Corteel, 1977). In contrast, local breeds from low latitudes (tropics) demonstrate little or no seasonality at all. Between these two extreme ecozones, intermediate latitudes as in the subtropics and the Near East, are interesting because of their geographical situation. Improvement of lamb and kid production in this area through the utilization of either native breeds or their crosses with imported breeds is influenced by the degree of their seasonality. Understanding the seasonality of reproduction and its control under these conditions is particularly important for developing programmes in which more than one lamb/kid crop per year is desired. It is also important for the planning of mating seasons to fit with feed resources availability and marketing requirements.

## SEASONALITY OF REPRODUCTION IN LOCAL SHEEP AND GOAT BREEDS

### Oestrous and Ovarian Activities :

Generally, a high level of cycling activity in local sheep breeds in the subtropics is maintained throughout most of the year, with a detectable drop during spring months. Aboul-Naga et al. (1987b) analyzed data of monthly oestrous activity obtained on Egyptian Ossimi (O) and Rahmani (R) breeds in 13 different trials (5 for R and 8 for O) reported by several investigators. The authors concluded that the two breeds showed oestrous activity all the year round without a clear anoestrous period but with a drop from February to July (Fig. 1). The observation that the period of low cycling activity or anoestrus being limited to spring months has been also reported in Barki ewes in Egypt (Rakha et al., 1988), in D'man and Sardi ewes in Morocco (Lahlou-Kassi and Boukhliq, 1988), in Awassi sheep in Israel (Amir and Volcani, 1965a) in Barbarine ewes in Tunisia (Khaldi, 1984) and in Chios sheep in Greece (Avdi, et al., 1988). Variation in the degree of seasonality of cycling activity has been reported, however, among local breeds raised at the same location. Aboul-Naga and Aboul-Ela (1987) reported that Rahmani ewes have more consistent oestrous activity than Ossimi. Mousa(1986) concluded that Awassi was more seasonal than both Ossimi and Rahmani, when raised at upper Egypt. D'man ewes were reported to be less seasonal than Sardi and Timhadit in Morocco (Lahlou - Kassi and Boukhliq, 1988) and Chios was reported to be less seasonal than Serres in Greece (Avdi et

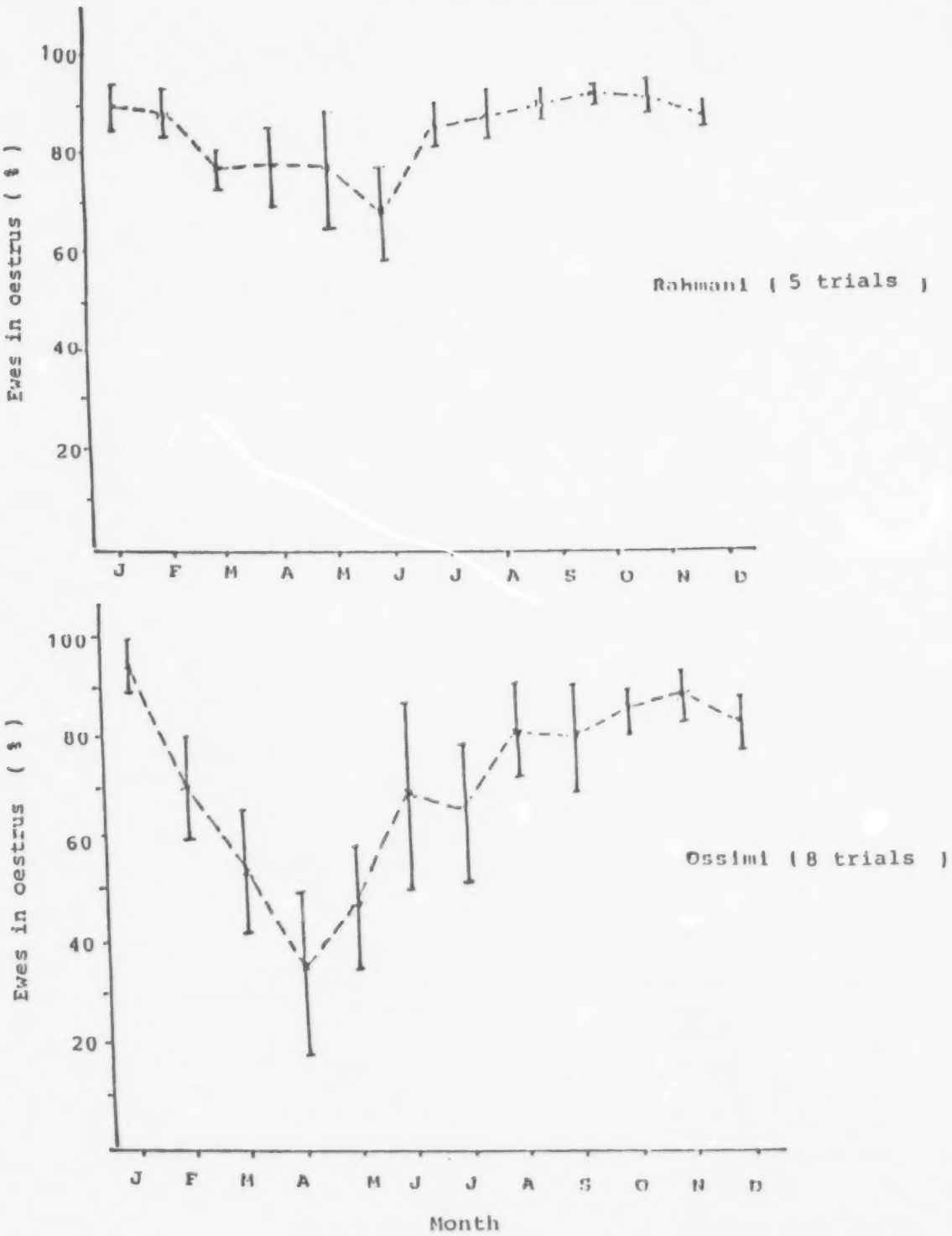


Figure 1 : Monthly percent of ewes in oestrous for the two local Egyptian breeds.

al., 1988). Within breed flock to flock variation was also reported in both Ossimi and Rahmani ewes (Aboul-Naga and Aboul-Ela, 1984 and 1987), but this is restricted usually to the period from February to July. Individual variation within flocks in the seasonality of oestrous activity has been reported. Aboul-Naga et al. (1987a) found that about one third of 29 R ewes studied continued to have ovarian activity all the year round. With such individual variation , Aboul-Naga and Aboul-Ela (1987) recommended the selection for more consistent cycling activity in local ewes for improving their general reproductive performance. Rahmani ewes which were the earliest to show oestrus after spring lambing were significantly of better reproductive performance than those which were the latest to show oestrus (Aboul-Naga et al., 1987b).

In almost all investigations where both oestrous and ovarian activities were studied, seasonality in oestrous activity was more pronounced than in ovarian activity (Khaldi, 1984, Aboul-Naga et al., 1987a, Avdi et al., 1988, Lahlou-Kassi and Boukhliq, 1988). It could be concluded that expression of oestrous symptoms is inadequate criterion for measuring cycling activity in subtropical local sheep breeds. Cyclicity is better assessed through monitoring ovarian function using clinical methods as blood progesterone concentration measurements or laparoscopy. Seasonality of cycling activity has been reported also in local goat breeds. Damascus goats in Cyprus present interesting characteristics of reproduction (Constantinou, 1981). In a limited group of does recorded for oestrus incidence for a whole year, regular activity of oestrous behaviour occurred only in autumn, sporadic oestrous periods were observed until the end of January and in July, oestrous activity ceased again until the middle of September. In the Nile Delta (Northern Egypt), Egyptian Nubian "Zaraibi" goats demonstrated an anoestrous season from February to June with a marked drop in the percentage of does in oestrus in March and a few number of does (<30%) showing oestrus in April-May (Aboul-Ela et al.,1988, Fig. 2A). In Upper Egypt, Baladi goats (local goats of unprecisely defined characteristics) demonstrated very low seasonal variation in oestrous activity (F. El-Hommosy, Unpublished data) where percentage of does in oestrus per month decreased to 50 and 58% in March and June, respectively, and remained at > 80% during other months (Fig. 2B).

Similar results were observed in Baladi does raised in the western part of the Nile Delta (Younis et al., 1988). On the other hand, in another study performed by the Egyptian Animal Production Research Institute (Unpublished data) Baladi does raised at Mid-Delta exhibited clear anoestrous

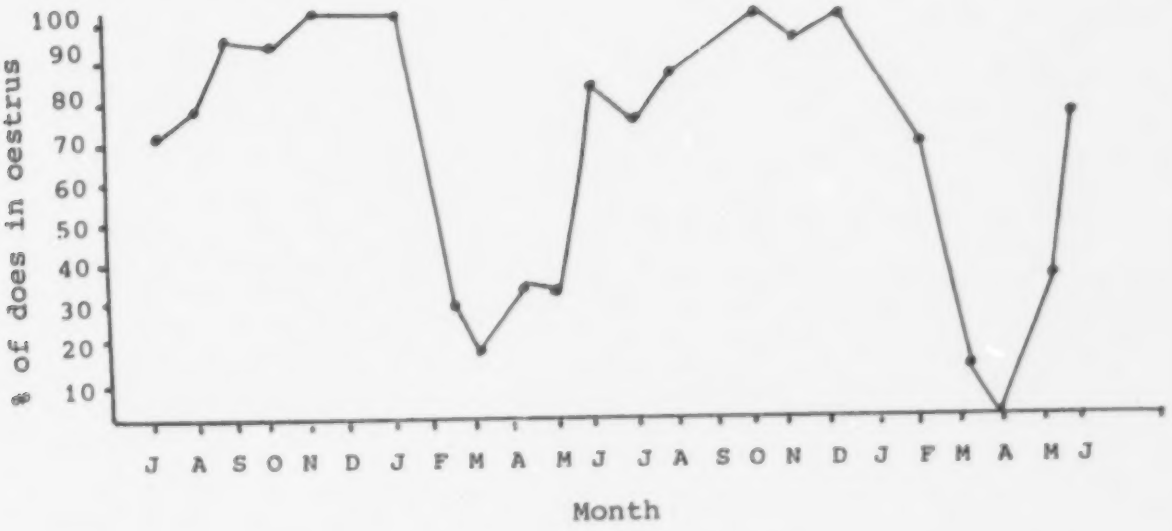


Figure: 2A. Monthly percentages of does in oestrus for Egyptian Nubian goats raised at north Delta, Egypt.

( After Aboul-Ela et al, 1988)

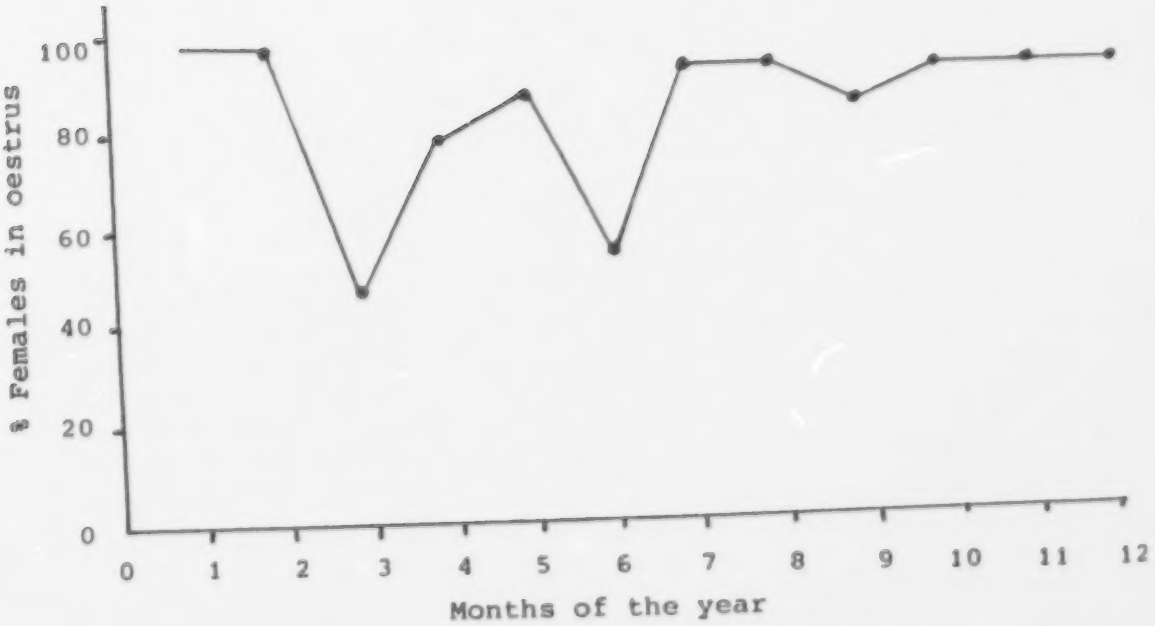


Figure: 2B. Monthly percentages of does in oestrus for Baladi goats raised at upper Egypt.

(After F. El-Hommossy, Unpublished data)

period during March-June, with clear individual variation. These results indicate differences in the seasonality of cycling activity between local goat breeds raised in the same country and between flocks and individuals of the same breed, similar to the situation in local sheep breeds. Conclusion on the seasonality of local sheep and goat breeds, therefore, cannot be generalized.

Compared to the trials reported on oestrous and ovarian activities of local breeds, few studies are available on the seasonality of ovulation rate. Aboul-Naga and Aboul-Ela (1987) reported that ovulation rate in both O and R ewes was lowest in May (1.19 and 1.29 for O and R, respectively) compared to the corresponding values recorded in January (1.33 and 1.50) and September (1.32 and 1.57). Seasonality in R, being more prolific, is more pronounced than in O. In Barbarine sheep in Tunisia, Khaldi (1984) reported that ovulation rate showed a peak in autumn months reaching 1.65 in October while it was less than 1.3 during the period of December - July. In Greece, seasonality in ovulation rate was reported to be more pronounced in Chios a very prolific breed, than Serres of lower prolificacy (Avdi et al., 1988). It ranged from 1.2 and 2.3 in March to 1.8 and 4.1 in October in Serres and Chios, respectively.

## BREEDING PERFORMANCE

Detectable seasonal variation was also reported in the breeding performance of local sheep breeds. In a recent study, Aboul-Naga et al. (1987b) concluded that under accelerated lambing system of 1 crop each 8 months with mating seasons in September, May and January, over 18 successive crops, September mating showed consistently the best performance expressed as number of lambs born for both O and R breeds. In that study, seasonal variation was more pronounced when expressed as fertility traits (per ewe exposed) than as prolificacy traits (per ewe lambed). Differences in litter size at birth per ewe exposed between September and May mating seasons was 36 and 29% in R and O, respectively. The relatively larger seasonal variation in litter size in R than O is consistent with the corresponding variation in ovulation rate for the two breeds.

## MALE REPRODUCTION

Fewer experiments were generally performed concerning seasonal variation in reproductive activity in male than in female small ruminants. Aboul-Naga et al.(1980) compared semen characteristics of Rahmani rams in both autumn

(September) and spring (May). Semen collected in spring was of better quality l(larger volume, higher concentration, better motility and lower abnormality).

Seasonal differences in semen quality can be attributed, as for cycling activity in the ewe, to both meteorological and nutritional factors. It is quite often that ambient temperature during summer days in the Near East region exceeds 30° C which is the upper for spermatogenesis. Exposure to long days is known to adversely affect sperm output and semen characteristics (Ortavant et al., 1985).

Galal et al. (1978) studied semen collected twice weekly during two month collection periods in the four geographical seasons. They reported that semen of Ossimi rams was of better quality in autumn and spring than in winter and summer. Mohamed (1978) observed that the highest semen quality and the strongest libido expression during summer and the lowest in winter in O and R breeds. In Awassi rams with regular semen collections, Amir and Volcani (1965b) reported that ejaculate volume was maximum in autumn and lowest in spring while the opposite was for sperm concentration. However, the authors did not find such seasonal differences to be distinct in rams without regular semen collection as those kept normally in the flock. In another study on Awassi rams, Juma and Dessouky (1969) reported that ejaculate volume and motility were lowest in winter and highest in summer. The noticeable variation in the results obtained in different studies on a particular breed could be attributed, among other factors, to the method used for studying seasonality in semen characteristics (frequency and method of collection, ram management and feeding). In addition, it has been reported in many studies that different traits used to assess semen quality behave differently in their seasonal variation(Amir and Volcani, 1965b, Galal et al., 1978, Aboul-Naga et al., 1980). The lack of single criterion that reflects gonadal activity in the male makes the evaluation in studying seasonal variation in male reproduction relatively more difficult than in females. We suggest that testicular volume and the total number of live normal sperms may fulfill this requirement.

In goats, Ashmawi(1979) working on Baladi buck in Egypt, reported significant effects of season on some sexual behaviour parameters but not on others. Although some behavioural characteristics in that study appeared not varying significantly with season, a tendency existed for higher activity in autumn than in spring. Male Damascus goats raised in Egypt showed significant seasonal variation in their sexual activity and semen traits, (El-Wishy et al., 1971, El-Saidy, 1988) where better performance was reported

in autumn and the lowest was that of spring.

It seems from those results that trend of seasonal variation in male reproduction of native breeds is clearer in goats than in sheep.

## EFFECTS OF ENVIRONMENTAL FACTORS ON SEASONALITY OF REPRODUCTION

Among the different environmental cues which act on reproductive activity (photoperiod, temperature, social relationships, feeding conditions), some appear to play an important role on seasonality of reproduction while some others only modulate reproductive activity. Moreover, the effects of these factors appear to be different depending on the considered breed and its geographical origin.

### Photoperiod

Under high and mid latitudes, photoperiod is the main cue which controls seasonal breeding in both sexes of small ruminants. In sheep and goat breeds of these zones, short or decreasing daylength stimulates sexual activity and long or increasing daylength inhibits it (Chemineau et al., 1988).

Only few trials were reported on the effect of photoperiod on oestrous and ovarian activities in local sheep breeds. Aboul-Naga et al. (1987a) found that changes in daylength, albeit of small magnitude (3.7 h) are a major factor influencing the seasonality of oestrous and ovarian activity in Rahmani sheep. Simulating the autumn daylength changes in spring caused an increase in oestrous and ovarian activities by about 40-50% and 30-45%, a respectively, as compared to a control group. It seems that there is breed difference in the effect of daylength changes on cyclic activity in subtropical sheep. Mousa (1986) reported that the effect of light treatment was more pronounced in the relatively more seasonal Awassi than Ossimi. In Morocco, Lahlou-Kassi and Boukhliq (1988) reported that increasing daylength caused a decrease in oestrous activity in D'man while Sardi ewes were not markedly affected. It is of interest to note that in both studies conducted in Egypt (Aboul-Naga et al., 1987a) and Morocco (Lahlou-Kassi and Boukhliq, 1988) the effect of photoperiod was more pronounced on oestrous activity than one ovarian activity. To our knowledge, there is no report on the effect of experimentally manipulated photoperiod on reproductive activity in local goat breeds in the subtropics.

**Social Relationships :**

Inter-individual relationships could strongly act on seasonal reproductive ability of females. Presence of lambs/kids and sudden re-introduction of males (so-called "male effect") are able to change oestrous and ovarian activities. Suckling causes a delay in the onset of first post-partum oestrus. Sudden re-introduction of bucks after a period of complete separation induces, in an ovulatory females in shallow anoestrus, synchronous onset of first ovulation within few days (Chemineau, 1987). Similar results were reported also in Rahmani sheep (Hassan et al., 1988). However, in goats the first ovulations are not always associated with oestrous behaviour and most of them are followed by short life span, corpora lutea. It seems also that there is a "female effect" on breeding activity in the male. Amir and Volcani (1965b) noted that the pattern of seasonality in semen characteristics of Awassi rams separated from ewes differed from that of rams with ewes in the flock.

**Age :**

The only information available on the effect of age on seasonality of cyclic activity of small ruminants in the subtropics is that reported by Khaldi (1984) on Barbarine sheep. He found that seasonality in both oestrous and ovarian activities was much more pronounced in ewes lambs than in adult ewes.

**SEASONALITY OF REPRODUCTION IN INTRODUCED TEMPERATE BREEDS AND THEIR CROSSES WITH NATIVE BREEDS.**

Many attempts were made in the Near East to cross local sheep with exotic breeds , mainly to improve lamb production . However, only few trials were reported on the seasonality of reproduction of introduced pure breeds. The results reported by Aboul-Naga et al. (1985) on seasonality of oestrous activity of Fleisch Mutton Merino bred in Egypt for more than 15 years indicated that almost all ewes had anoestrous period during April, May and June which is similar to the performance of Merino ewes in Australia and Britain. Suffolk ewes produced in a flock imported into Egypt (Aboul-Naga et al. 1985) and bred for many generations had a distinct breeding season (from August to January) similar to that found in its home country. These results were supported by the findings of Aboul-Naga et al. (1984) and Aboul-Ela et al. (1987) who compared the performance of Finn ewes raised in Finland with their half-sibs imported into Egypt. The breeding season was similar in the two

groups starting on 4th October ± 3.2d and 10 October ± 4.9 d in Egypt and Finland, respectively, while it ended on 31 May ± 4.8 d and 13 May ± 14.9 d in the two countries, respectively. Both groups showed also similar degree of seasonality in ovulation rate. It is important to note that the similarity in seasonality of cyclic activity was found despite large and sizable differences between the two groups in the physiological traits related to thermo regulation and metabolic activity l(Aboul-Ela et al., 1987). The results of the aforementioned studies demonstrate clearly the importance of inherited physiological rhythm that control seasonality of oestrous and ovarian activity in these breeds, and that the drastic changes in environmental conditions were not able to over-ride this inherited rhythm.

Similar to the situation in sheep, when transferred to low latitudes, temperate breeds of goats maintained their seasonality. French Alpine does transferred into a tropical (West Indies, Cognie, 1971) or a subtropical climate (Aboul-Naga and Aboul-Ela, unpublished data), or artificially maintained in a light-proofed building under a "simulated tropical" photoperiod (Chemineau et al., 1988) began their ovulatory and oestrous activity in September and stopped in February-March. However, the careful examination, during three consecutive years (Chemineau et al., unpublished results) of the characteristics of the sexual season in "simulated tropical" (11-13 h of light, Tr) compared to "simulated temperate" (8-16 h of light, Te) environment indicated that : (a) total duration of the sexual season was 18 to 49 d longer (varying between years) in Tr than Te does, (b) oestrus without associated ovulation and ovulation without oestrus occurred more frequently in Tr than Te (34 v. 8% and 31 av. 18%, respectively), (c)incidence of short cycles (mean duration 7 days) was also higher in Tr than Te does (36 v. 14%), (d) ovulation rate appeared slightly lower in Tr than Te goats (1.67 v. 1.81). This characteristic of seasonality seems to be mainly of genetic origin as it persisted over the generations.

In rams, Amir and Volcani (1955b) studied the seasonal changes in semen characteristics of German Mutton Merino, Corriedale, Border-Leicester and Dorset Horn breeds from which semen was collected regularly throughout the year. They found that the seasonal variations in semen characteristics in the studied breeds were parallel to the respective degree of seasonality reported for them at their countries of origin, This indicates the genetic role in controlling seasonality of male reproduction under the prevailing natural environment.

In Merino rams which were born and reared locally in Egypt, Galal et al. (1978) concluded that semen quality land libido were better in autumn and spring than in summer and winter, similar to the native Ossimi. Finn rams imported into Egypt (F. Hassan, personal communication) showed some seasonality in semen characteristics with high percentage of abnormal and dead sperms in summer months, especially August, which was mainly attributed to the prevailing high ambient temperature. As in the female, Alpine bucks imported into Egypt (Mousa, 1987) presented marked seasonal variation in semen characteristics, similar to what is observed in Europe.

## CROSSBREEDING WITH NATIVE BREEDS

Only limited trials were carried out to investigate the seasonality of oestrous and ovarian activity in crossbreds between local and exotic breeds in the subtropics. In most of these trials, there was evidence of heterosis in the cyclic activity and reproductive performance. Crossbreds between Ossimi and each of Suffolk land Merino were reported to have higher and less seasonal oestrous activity than their respective pure breed parents (Aboul-Naga et al., 1985), with the 50% Suffolk and 1/4 Merino having the best performance. The percentage increase in the actual incidence of oestrus over the expected contribution of pure breed parents throughout the year averaged 24 and 47% in 75% and 50% Suffolk land were 45, 43, and 68% in 3/4, 1/2 and 1/4 Merino, respectively. This superiority was mainly during March-August while the differences were minimum during September-February, the common breeding season for most sheep breeds.

Schindler and Amir (1985) reported pooled estimates of lambing percentage of Finn x Merino and Finn x Awassi crosses under accelerated lambing system of 3 crops/2 yr, being 58.6, 81.9, and 83.3% for June, December-January and September matings, respectively, although no attempt was made in that study to distinguish between the two groups of crossbreds, Under accelerated lambing system in Egypt, with malting season in January,, May and September, Aboul-Naga and Aboul-Ela (1988) reported lower fertility and prolificacy for Suffolk x Ossimi crossbreds in May mating compared to September and January matings. Similarly, Aboul-Naga et al. (1988)reported lower conception rate and lower prolificacy l(lambs born per ewe lambed) in May mating season than September and January in different crosses between Finn and Ossimi and Rahmani subtropical breeds. This summed up to a difference of about 39% in number of lambs born per ewe exposed between May mating in

one hand and September and January matings on the other. Differences of similar magnitude were also reported by Goot et al. (1984) in Finn x Awassi crosses. Aboul-Naga et al. (1988) reported that seasonality of prolificacy in crossbreds between Finn and each of Ossimi land Rahmani was much more pronounced than that of fertility. In crossbreds between Anglo Nubian and Baladi goats in upper Egypt (El-Hommosy, unpublished data) oestrous activity was higher and continued for longer period than the Anglo-Nubian but less than the Baladi. In the crossbred, a period of anoestrus was observed from January to July 76 while in the pure Baladi always more than 50% of the does showed oestrus.

Information on the seasonality of reproductive activity in crossbred rams between exotic and native breeds are scarce. Galal et al. (1978) working on Merino x Ossimi, reported significant breed x season interaction. Most of the differences between seasons in different grades of crosses were not consistent from one semen trait to another.

## CONCLUSIONS

Most native sheep and goat breeds in the Near East show a drop in oestrous and ovarian activity during spring months. However, description of the nature of this seasonality cannot be generalized. Breed, flock and individual variations have been reported with the seasonality being more pronounced in oestrous than ovarian activity. Hence, clinical methods should be used to distinguish between them. The prevailing small changes in photoperiod in the Near East can affect cyclic activity with the effect being more pronounced on oestrous than ovarian activity. Despite this relatively small effect, control of seasonality seems to be mainly of genetic origin, as indicated by the maintenance of seasonal reproduction in temperate breeds imported into the subtropics, and the heterosis in the seasonality in crosses between native and imported temperature breeds. Seasonality in reproductive functions in the male is less defined than in females, particularly in sheep.

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# CONTROL AND MANIPULATION OF REPRODUCTIVE FUNCTIONS IN NATIVE SHEEP

A. LAHLOU-KASSI; R. BOUKHLIQ; A. TIBARY AND A. SGHIRI

Department of Animal Reproduction and A.I,
Agronomic and Veterinary Medicine Institute Hassan II,
B. P 6202 Rabat-Instituts, Morocco.

## INTRODUCTION

Improvement of productivity in sheep flocks, when adequate management and feeding are available, can be achieved by increasing litter size and or by accelerating lambing.

Our native sheep are characterized by relatively low litter size ( except D'man breed in Morocco and Chios in Cyprus), the existence of a seasonal anoestrus from February to April, a post-partum anoestrus ranging from 60 to 160 days during normal lambing season, and a rate of 1 to 1.3 lambing per year.

Several trials were conducted in North Africa and Middle East to control and manipulate reproduction in native sheep. The techniques used are : nutritional manipulation based on short term effect of nutrition, light treatment by modifying the day length, hormonal control and manipulation of ovulation and cycle activity, and the ram effect.

In this review, we are summarizing those trials and evaluating how much improvement of reproductive performance can be achieved through these techniques.

## NUTRITIONAL MANIPULATION

The Near East region is characterized by a marked seasonality in the availability of food. Ewes then, may be underfed during pregnancy and in the mating season.

Feeding level of ewes before or after lambing has been shown to influence the resumption of cyclicity in Barbarine ewes (Table 1; Khaldi, 1984). The percentage of cycling ewes during the suckling period has been significantly increased when a 12 week supplementation period before lambing was performed. On the other hand, the post lambing

supplementation resulted in shortening post lambing ovulation interval. Nevertheless, the first ovulations were mostly silent; 85% of the females have shown an oestrus during suckling period.

TABLE 1

Effect of pre and post partum body weight on resumption of ovarian activity and oestrous behaviour (From Khaldi, 1984).

| Group[1] | Interval lambing-1ère ovul. | Number of silent ovul. | % of females in oestrus |
|---|---|---|---|
| H.H | short | 1.3 | 77 |
| H.L | long | 1.1 | 100 |
| L.L | long | 1.2 | 50 |
| L.H | short | 2.3 | 85 |

[1] H.H : ewes receiving a high feeding level before and after lambing.
H.L : ewes receiving a high feeding level before lambing and a low one during suckling.
L.H : ewes receiving a low feeding level before lambing and a high one during suckling.
L.L : ewes receiving a low feeding level before lambing.

Table 2 shows clearly the effect of body condition 9 weeks before ram introduction on early cyclicity in the breeding season. The highest number of cycling females before joining were recorded in the heavy groups independently of losses in weight thereafter. However, conception rate and litter size were relatively lower when body weight decreases before mating. The highest conception rate and litter size were obtained when the body weight was significantly increased before the introduction of the ram.

## LIGHT TREATMENT AND CYCLICITY

It is well documented that ovarian activity and the associated periods of behavioural oestrus in the ewe are influenced by photoperiodism. Since in our latitude (30-34° N) the change of daylength is not as abrupt as in the north, seasonal anestrous is less pronounced. In order to test the sensitivity of native breeds to photoperiodic variations some light regimes have been applied on Moroccan Sardi breed and Egyptian fat tail Rahmani breed.

TABLE 2

Effect of body weight changes before mating on cyclicity, conception rate and litter size (From Khaldi, 1984).

| Group[1] | % of ewes with CL before & after lambing | | Ovulation rate | Conception rate (%) | Litter size (%) |
|---|---|---|---|---|---|
| HH | 40.8 | 87.5 | 1.29 | 62.5 | 112 |
| HL | 40.8 | 76.9 | 1.10 | 38.5 | 100 |
| LL | 6.1 | 65.2 | 1.27 | 26.1 | 100 |
| LH | 6.1 | 91.3 | 1.43 | 78.3 | 117 |
| AA | 12.5 | 90.5 | 1.42 | 66.7 | --- |

[1] L (light ewes) : 39.3 ± 2.6 kg, H (heavy ewes) : 52.5 ± 3.5 kg, A (average ewes) : 45.8 ± 1.2 kg.
Group LL : 25 light ewes keeping a constant live weight.
Group LH : 24 light ewes gaining weight.
Group HH : 24 heavy ewes keeping a constant live weight.
Group HL : 25 heavy ewes loosing weight.
Group AA : 25 average ewes keeping a constant live weight.

In Morocco, Lahlou-Kassi and Boukhliq (1988) followed ewe performance under natural photoperiod (32° N) and artificial photoperiod corresponding to the latitude of 56° N. All ewes were checked daily for oestrous behaviour, progesterone level was also determined on a weekly basis. Results showed that sexual activity in the ewes seemed to start in May and listed until November in the control group, whereas 2 month delay in the onset of the breeding season was observed in Sardi ewes under Scottish photoperiod. During May and June, the percentage of females in estrous and females with corpora lutea was significantly lower than in the control one. Light treatment was able to delay the onset of breeding season in the Sardi breed. In Egypt, similar trial conducted on fat tailed Rahmani ewes (Aboul-Naga et al., 1987) showed a slight decrease in ovarian and estrous activity during increasing daylength (Jan-May). With gradual decrease daylength, the percentage of ewes showing oestrus was markedly higher in treated group.

With appropriate light regime one can expect to modify the onset of breeding either by advancing or delaying this period.

## MANIPULATION OF THE OESTRUS CYCLE USING EXOGENOUS HORMONES

Hormonal treatments to induce or control the oestrous

cycle in the ewe are widely used in different parts of the world. The treatment most used is a combination of progestagen and PMSG and in a lesser manner PGF2alpha.

In African countries, the use of these techniques could be a rather important management tool for farmers in order to :

- Concentrate lambing in favorable season to avoid lamb mortality resulting from heat or cold stress, and avoid uncontrolled breeding throughout the year in non seasonal breeds.

- Advance the breeding season in ewe lambs.

- Allow better feeding management through synchronization of the flock especially in areas of transhumance or nomadism.

- Increase production efficiency by increasing lambing frequency and better use of selected rams through artificial insemination.

**Oestrus Synchronization Using PGF2ALPHA.**

PGF2alpha are used generally in a two injections regimen at 9 to 11 days interval in cyclic ewes (Gordon, 1983). However, response to this treatment is variable.

In Morocco, PGF2alpha was used in D'man and Timahadite ewes (Tibary et al., 1988) resulting in oestrous response of 65% and 47% and fertility of 34.8% and 13.0% following A.I at predetermined time for the two breeds, respectively. The response to PGF2alpha treatment was found to be variable and most likely due to spread of oestrous response and incomplete luteolysis in non responding animals. Optimal condition for successful mating or A.I are still to be defined.

The implacability and cost involved in this treatment which is limited to cycling ewes may render this technique non profitable for the farmer.

**Oestrus manipulation with progestagen**

Progestagen treatment combined with gonadotrophin such as PMSG, HCG, HMG or GnRH are used in order to advance breeding season, to synchronize oestrus or to increase prolificacy.

In ewe lambs, few studies are reported on use of this technique in native breeds. A recent study by Hamra et al.

TABLE 3

Results of experiments on oestrus synchronization using progestagens.

| Breed | (n) | Treatment | % of response | Lambing rate (%) | | Author |
|---|---|---|---|---|---|---|
| Beni Hsen | (29) | Progest No PMSG | 69 | 55 | NB[1] | Lahlou-Kassi and Marie (1977) |
| Beni Hsen | (54) | Progest PMSG (500iu) | 87.5 | 56.5 | NB | Dkhissi (1977) |
| Karakul | (40) | FGA PMSG (500iu) | 92.5 | 55 | NB | Acritopoulou et al. (1982) |
| Karakul | (60) | | 96.6 | 25 | AI | |
| Sardi | (34) | FGA PMSG | 53 | 3 | AI | Manar et al. (1988) |
| D'man | (30) | | 76 | 10 | AI | |
| D'man | (23) | FGA PMSG (400iu) | 100 | 21.7 | AI | Tibary et al. (1988) |
| Timahdite | (23) | | 91 | 39.1 | AI | |
| Timahdite | (50) | FGA PMSG (300iu) | -- | 10 | AI | Tibary et al. (1988) |
| Timahdite | (50) | | -- | 20 | NB | |
| Timahdite | (100) | control | -- | 70 | NB | |
| Awassi | (10) | MAP HCG (150iu) | 100 | 100 | NB | Hamra and al. (1988) |
| Awassi | (10) | MAP HCG (500iu) | 90 | 50 | NB | |
| Awassi | (10) | MAP PMSG (500iu) | 100 | 100 | NB | |
| Awassi | (10) | MAP GnRH (50Mg/6h for 8 h) | 100 | 80 | NB | |
| Awassi | (10) | control | 50 | 40 | NB | |

[1] AI : artificial insemination, NB : natural breeding

Preliminary results obtained from Sept.-Oct. mating in Morocco and Egypt in Sardi, Rahmani and the Finnish Landrace x Rahmani ewes are shown in Table 5. Primary and booster injections of Fecundin were given 6 and 3 weeks before the start of the mating season in Egyptian ewes (Aboul-Ela et al., 1988) and 6 and 2 weeks in Moroccan ewes. In both cases, the immunization against androstenedione resulted in a reduced fertility and a significant increase in ovulation rate. The increase in ovulation rate was mainly due to an

TABLE 4

Effect of dose of PMSG on ovulation rate in different native breeds.

| Breed | (n) | PMSG dose | Ovul. rate | Season | Author |
|---|---|---|---|---|---|
| D'man | (30) | 400 iu | 3.03±1.88 | December | Manar et al. (1988) |
| | (20) | 250 iu | 2.90±1.2 | October | Tibary et al. (1988) |
| | (18) | 500 iu | 4.1 ±1.9 | October | Tibary et al. (1988) |
| Timahdite | (21) | 250 iu | 1.3 ± .7 | October | Tibary et al. |
| | (27) | 500 iu | 2.6 ±1.6 | October | (1988) |
| Sardi | (38) | 400 iu | 1.79± .84 | December | Manar et al. |
| | (35) | 300 iu | 1.27 | April | (1988) |
| BeniHssen | (24) | 600 iu | 2.4 ± .4 | March | Dkhissi (1988) |
| Awassi | | 500 iu | 150% prolificacy | | Hamra and Jassim (1988) |

TABLE 5

Reproduction performance of Sardi (Morocco), fat tailed Rahmani and Finnish Landrace x Rahmani crosses (Egypt) immunized against androstenedione.

| Breed | (n) | Ovulation rate | % of ewes with CL 1 | 2 | 3 | 4 | CR[1] % | Litter size | % of ewes with litter size of 1 | 2 | 3 | LBJ[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sardi treated | (40) | 1.62±.55 | 41 | 56 | 3 | - | 42 | 1.38±.5 | 62 | 38 | | .58 |
| Sardi control | (20) | 1.35±.49 | 65 | 35 | - | - | 67 | 1.25±.45 | 75 | 25 | - | .83 |
| Rahmani treated | (47) | 1.98±.11 | 26 | 53 | 19 | 2 | 77 | 1.47±.10 | 58 | 36 | 6 | 1.13 |
| Rahmani control | (41) | 1.76±.09 | 32 | 61 | 7 | - | 85 | 1.46±.09 | 54 | 46 | - | 1.24 |
| FL x R treated | (51) | 1.90±.07 | 17 | 75 | 8 | - | 84 | 1.63±.08 | 37 | 63 | - | 1.37 |
| FL x R | (39) | 1.69±.09 | 36 | 59 | 5 | - | 92 | 1.47±.08 | 53 | 47 | | 1.36 |

[1] CR : conception rate,
[2] LBJ : lambs born per ewe joined.

(1988) showed that treatment with MAP sponges for 14 days followed by injection of 500 i.u HCG induced ovulating oestrus at variable levels in Awassi, Karadi and Arabi ewes (Table 3). Condition (body weight) of ewe lambs would be the major factor for success of such treatment.

In adult ewes, fertility, in general is very low especially after A.I at predetermined time. Investigations on effect of FGA/PMSG on ovulation rate in different breeds in Morocco showed that the response to PMSG depends on level of this hormone and the breed used (Table 4). Breed difference is mainly due to their seasonality and their natural ovulation rate.

**EFFECT OF ACTIVE IMMUNIZATION AGAINST ANDROSTENEDIONE ON OVULATION RATE AND FECUNDITY**

Through luteal regression mechanisms investigations, it was observed that the follicular growth and the ovulation rate are stimulated in ewes passively immunized against oestradiol (Rhind et al 1986; Boland et al 1986). Immunization against ovarian steroids could be a valuable commercial method to improve ovulation rate. Ovulation response of ewes immunized against androstenedione and oestrone in many trials (Robinson and Scaramuzzi, 1986; Rhind et al., 1986) showed some problems such as low fertility, anovulation, silent ovulations, and antibody titters variability which was mostly related to adjuvants nature.

The exact mechanism of ovulation rate increase in immunized ewes against androstenedione is not well known. Scaramuzzi et al. (1980) found an increase of the mean LH level along the oestral cycle in immunized ewes against androstenedione which was due to LH pulsatile discharge elevation during follicular phase. A hypothesis drawn by Alifakiotis (1986) states that immunization against androstenedione may reduce circulating androgen concentrations and thereby reduce follicular inhibin production, this in turn may reduce the feed back suppression of pituitary FSH secretion and so allows more follicles to be stimulated to develop to ovulatory maturity. In a recent study, Philipon (1988) postulated that the increase of ovulation rate in immunized ewes could be due to the linkage of progesterone to anti-steroid antibody which reduce the paracrine inhibitory effect of this hormone on the ovary.

Generally, the immunogen is given over two subcutaneous injections 2 to 3 weeks apart with the second given 2 to 4 weeks before mating.

increased incidence of double ovulations and the appearance of triple ovulations in Sardi ewes and quadruple ones in Rahmani ewes. However, this increase in ovulation rate was not reflected in an increase of litter size (Table 5). Boland et al. (1986) has noted in Merino ewes that 7 to 14 days after the booster injection, the mean litter of antibody was high and had declined significantly by day 25. This yields the ewes temporarily infertiles with reduced pregnancy rates. Also, the number of lambs born per ewe joined was significantly lower in Sardi treated ewes than in control ewes, but in Rahmani and their crosses with Finnish Landrace, the differences between the treated and the control groups were small and inconsistent.

The relatively smaller increase in litter size resulting from treatment, compared to that of ovulation rate was mainly due to the increased reproductive wastage. Increased ovulation rate in ewes immunized with Fecundin was associated with reduced fertility rate and/or increased embryonic loss. If this problem is overcome, immunization could practically improve the overall reproductive performance of African ewes in Mediterranean environments since the androstenedione immunogen commercially manufactured.

**USE OF RAM EFFECT AS A MANAGEMENT TECHNIQUE UNDER NORTH AFRICAN CONDITIONS**

Transition from the non breeding to the breeding season in ewes achieved by exposing isolated ewes to the ram. This induces a series of neuroendocrine responses which result in ovulation, oestrus and conception. It has also been considered as an attractive and simple managerial practice for oestrus synchronization.

In ewes of shallow anoestrus, this technique works at any time during the non breeding season. In ewes of breeds characterized by deep anoestrus, it is effective only during the four to six weeks before the onset of the breeding season. This method has the advantage of being easy to manage under extensive conditions. And also, in the applied accelerated lambing system of three crops/2 years, where spring mating season results in less satisfactory conception rate and fecundity.

Normally the first ovulation after ram introduction is not accompanied by oestrus but one cycle later (i.e. about 19 days after the initial stimulus) the ewe both ovulates and show behavioural oestrus. One problem is that unpredictable number of ewes well have a "short cycle" and re-ovulate following the first ovulation (about six days later). This

means that there is a very poor synchrony of oestrus around day 19 because the ewes experiencing short cycles will not show behavioural oestrus for the first time until around day 25 after stimulus. To obtain a high degree of synchrony between days 18 and 21 after the stimulus was applied, an important practical finding was that a single injection of 20 mg progesterone given at the time that ram stimulus was applied eliminates short cycles.

**Ram effect during the breeding season**

The response of ewes to ram introduction depends on the anoestrus intensity. Under Moroccan conditions, lambing distribution throughout the year show that there is decrease in number of ewes lambing during August-October period in Sardi ewes whereas in D'man the distribution is more uniform. This suggest a lower fertility in Sardi ewes for February-April mating period.

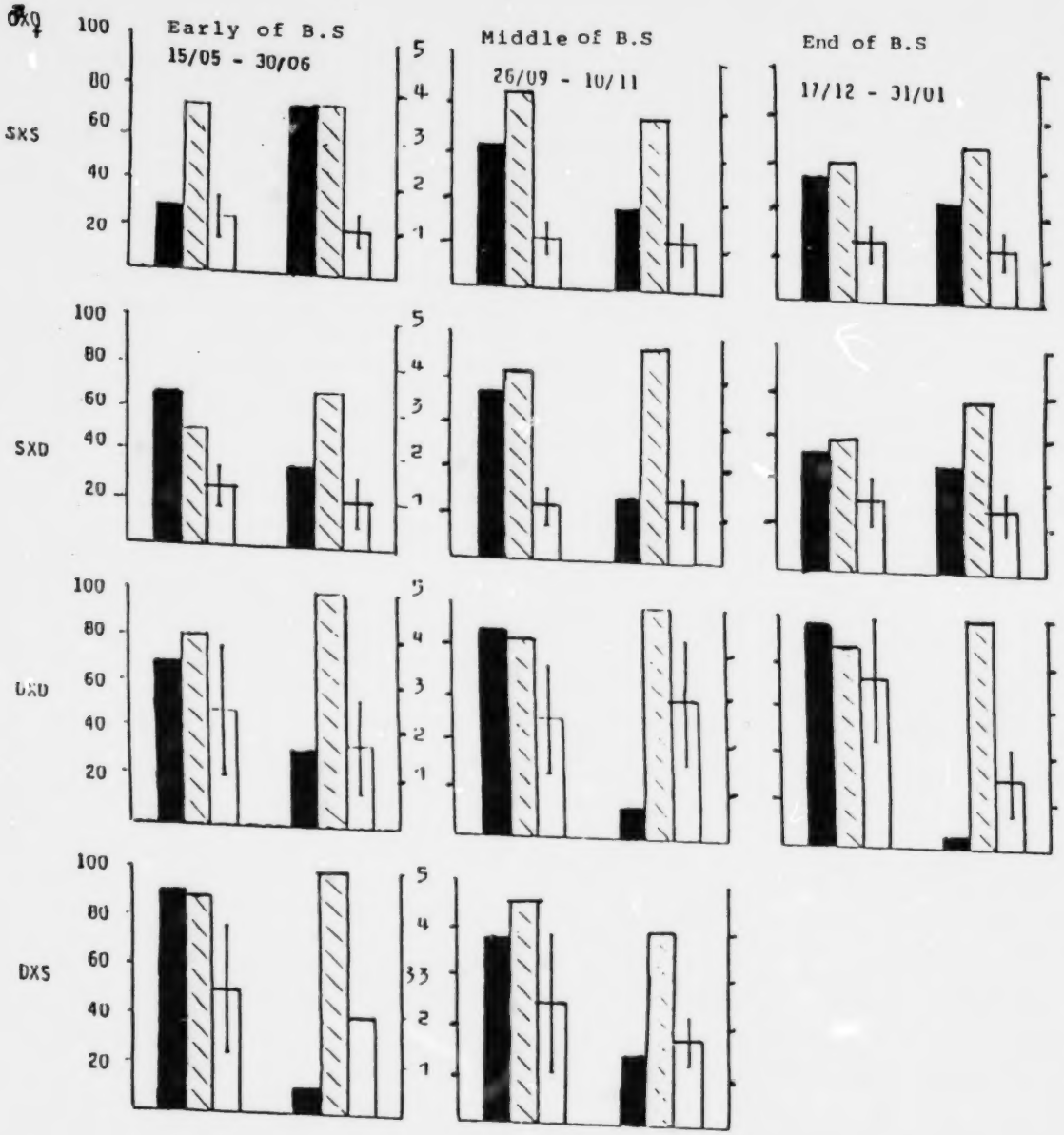
To test the effect of exposure to ram, records from 3 mating seasons were analyzed according to dam and sire breeds. All the matings periods lasted 45 days, heat and mounting were checked by using harness fitted rams. Ovulation rate was determined by laparoscopy 3 to 7 days in mated ewes. Results of the analysis are shown in Fig 1. During July-Sept joining period, most of matings (>60%) occurred in the first 17 days of the period, averaging a fertility of 80% independently of ewes and sire breeds.

During May-June joining period, when Sardi ewes were joined to Sardi rams, 15, 24 and 41% of them were bred, respectively, around the 9$^{th}$, the 24$^{th}$ and the 41$^{th}$ day of joining. Fertility rate for these groups was 73, 83 and 80%. These results suggest that most of Sardi ewes were not cycling at joining. When D'man rams were used, 60% of the matings were recorded before the 12$^{th}$ day, showing that D'man rams can induce more behavioural estrus than Sardi rams.

D'man ewes did not show any difference in matings pattern whether bred to Sardi or D'man rams. Results from this period were comparable to those obtained in July-September mating.

In December-January matings, all D'man ewes were bred by the 17$^{th}$ day of the joining period, whereas for Sardi ewes, breeding lasted 30 days for both sire breeds. Ovulation rate did not change from one period to another and accordingly to sire breed. However an increase in ovulation rate was recorded for D'man ewes joined to D'man rams during December-January.

These results suggest some practical use of ram effect




Important:

* B.S = Breeding season
SxS = Sardi♂ x Sardi♀
SxD = Sardi♂ x D'man♀
DxD = D'man♂ x D'man♀
DxS = D'man♂ x Sardi♀

▬ : % of females in oestrus
▨ : % of fertile service
▭ : ovulation rate

Figure 1 : Ram effect in Sardi and D'man Breeds of sheep

under Moroccan conditions for management of joining period where male effect can be used for Sardi ewes when mated in May-June season. Similar observations were made by Hassan et al., (1988) on Egyptian Rahmani ewes mated in the same season. Their results showed that the proportion of ewes displaying oestrus within 16-24 days after approyed ram introduction was better when the period of exposure to ram was extended from 4 to 8 days. This indicates a minimum period required of ram contact to achieve the male effect. Considering a 5 weeks period of mating (the normal length of mating season in the applied system of 1 crop/8 months), the percent of Rahmani ewes mated was increased and control groups, respectively (Hassan et al., 1988). In Barbarine ewes, induced ovulation was shown in 97.5% of ewes and 87% of the ewes ovulating in response to the introduction of rams showed oestrus within 26 days. The prolongation of mating season up to 45 days can be avoided by using the ram effect in those three breeds for May-June mating season.

Vasectomized d'man ram used as a teaser may offer better introduction and synchronization than Sardi ram. Joining period in December-January for Moroccan ewes can be reduced to one month without any loss in fertility.

**Ram effect during the post partum period**

Ovarian activity in post parturient ewes could be re-established by the introduction of males. The response of the females to the presence of the males increased progressively as the interval between lambing and introduction of rams after lambing lengthened (Khaldi, 1984). The induced ovulation was always silent. Short cycles frequency was higher when male was used 15 days after lambing (Table 6). Duration of these short cycles was then 7.6 ± 2.1 days in average.

## CONCLUSIONS

The hormonal treatments used in estrous synchronization or increase litter size are not yet well established in native sheep in the Near East.

The fecundity and prolificacy rates could be improved when adequate supplementary feeding is done according to the mating and lambing season.

The trials on ram effect give promising results that need to be tested by comparing several ram breeds.

TABLE 6

Response of Barbarine post-parturient ewes to male effect (From Khaldi, 1984).

| | Days after lambing | | |
|---|---|---|---|
| | 15 ± 2 | 25 ± 2 | 35 ± 2 |
| Ovarian activity before introduction of rams (%) | -- | 40 | 40 |
| Ovulations induced in non cyclical females (first 3 days) % | 70 | 91.7 | 100 |
| Frequency of short cycles % | 71.4 | 27.3 | 25 |
| Induced ovulation rate | 1.41 | 1.64 | 1.42 |
| Ewes returned to anoestrus after response to ram introduction %. | 35.7 | 27.3 | 58.3 |

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# MEAT PRODUCTION FROM GOATS IN SEMI-INTENSIVE SYSTEMS

M. HADJIPANAYIOTOU

Agricultural Research Institute, Nicosia, Cyprus

## ABSTRACT

Semi intensive kid fattening systems have been developed in some countries to meet the increasing demand for kid meat. In some instances kids from dual purpose breeds (milk and meat) are used for fattening. The system involves animals which respond to better feeding and managerial practises with fast growth, and relatively high investment on housing, veterinary supervision and on purchased or produced feed. The objective of the present paper is to describe briefly how nutritional (level of feeding, feed processing, nitrogen levels and sources, feed additives), genetic (selection of breed), managerial (castration) and health (handling of new arrivals, preventive measurements) aspects might affect growth performance, carcass characteristics, feed efficiency and subsequently the economic of semi-intensive kid fattening operations.

## INTRODUCTION

Goats are distributed throughout the world and they produce 25.3% of the world total meat supply from small ruminants (FAO, 1986). Goat meat is readily acceptable and in some countries is more costly per unit weight than lamb or beef (Kirton, 1982). In some countries, consumption of sheep and goat meat is not dependent on output from domestic producers, but on imports of live animals. Increasing animal numbers kept under traditional extensive conditions as a means of increasing production is not appropriate because grazing lands are already overstocked. As a result, semi-intensive/intensive fattening systems have been developed in some countries. In view of the high costs of such production systems there is an urgent need to take into consideration some factors related to nutrition, management, health, genetics and carcass quality which are closely related to their economics. The purpose of the present paper is to describe briefly how nutritional or other factors might affect the performance and subsequently the economics in semi-intensive kid fattening systems.

**FEED RESOURCES**

Kid fattening under semi-intensive/intensive feeding conditions can rely on good quality roughages, cereal grains, protein supplements and by-products of moderately good quality.

Leguminous grains (Hadjipanayiotou et al., 1985) are good sources of protein (260-313 g/kg DM) and can be successfully used as protein supplements in concentrated feeds. Growth rate, feed intake and feed conversion rate of kids were similar when soybean meal was replaced partly of completely by common vetch or broad beans (Table 1).

TABLE 1.

The effect of replacement of soybean meal (SB) by broad beans (BB) or common vetch grain (VG) on the performance of fattening kids offered concentrate ad libitum (Koumas and Economides, 1987).

| Trait | Protein supplement | | | | | |
|---|---|---|---|---|---|---|
| | SB | SB + BB | BB | SB + VG | VG | SE |
| Weight gain (g/day) | 248 | 274 | 232 | 234 | 261 | 21 |
| Feed intake (kg)* | | | | | | |
| Concentrates | 67 | 70 | 66 | 67 | 70 | -- |
| Lucerne hay | 7 | 7 | 7 | 7 | 7 | -- |
| Feed / gain ratio | | | | | | |
| Concentrates | 3.89 | 3.65 | 4.04 | 4.12 | 3.80 | -- |
| Concentrates+hay | 4.27 | 4.02 | 4.47 | 4.54 | 4.19 | -- |

* 70 days on test

Agro-industrial by-products (citrus pulp, beet pulp) and poultry wastes can also be used in semi-intensive kid fattening systems. Studies conducted in Cyprus (Hadjipanayiotou, 1984) showed that kids fed diets containing (150 and 300 kg/tone concentrate) dried poultry litter perform equally well as those on the control diet.

**Cereal grain processing and form of concentrate mixture**

Processing of cereal grains has been practised with the

purpose of ensuring better mixing of the ingredients. However, Orskov (1979) reviewing the available literature concluded that processing of cereal grains is unnecessary for sheep and goats, and he recommended feeding the cereal grains whole, mixed with pellets (3-5 mm cubes) from the other feed ingredients. Research work conducted at the Cyprus Agricultural Research Institute ( S. Economides et al., unpublished data) showed that although no processing is required for mature lactating ewes and goats and fast growing early weaned Chios lambs, feeding whole cereal grains to fast growing early weaned Damascus kids results in poorer performance compared to pelleted diets (Table 2). Lambs and kids on the mash diet had the poorest performance.

TABLE 2.

The effect of form of diet on the performance of male kids (K) and lambs (L) given a barley-based diet in different form.

| | Diet | | | | | |
|---|---|---|---|---|---|---|
| | Mash | | Pelleted | | Grains whole other ingredients pelleted | |
| | L | K | L | K | L | K |
| No. of animals | 12 | 12 | 12 | 12 | 12 | 12 |
| Weight gain (g/day) | 295 | 159 | 355 | 294 | 341 | 263 |
| Feed/ gain ratio | | | | | | |
| Concentrates | 4.03 | 7.75 | 3.73 | 4.10 | 3.83 | 4.83 |
| Concentrates + hay | 4.37 | 8.38 | 4.01 | 4.39 | 4.10 | 5.22 |

L= lambs, K= kids

Feeding young kids pelleted as opposed to whole grains resulted in an overall advantage of 54 g kid liveweight gain per day. Taking into consideration the feed intakes and liveweight gains obtained in our studies, and assuming UK £ 1.00 per kg kid body weight and UK £ 100.00 per ton of raw feed ingredients, it is calculated that pelleting can justify expenses up to UK £ 52.00 per ton; when compared to mash diets, pelleting expenses up to UK £ 93.00 can be justified. Similar calculations with lambs showed that additional expenses for pelleting cannot be justified.

## Growth rate

The success of any intensive kid fattening system depends on the choice of the right breed that will be capable of responding to better feeding and managerial practices. Growth rates for kids reported by Devendra and Burns (1970) are disappointingly low. Recent data however, from Norway (Skjevdal, 1974 cited by Naude and Hofmeyr, 1981), France (Fehr et al., 1976), South Africa (Naude and Hofmeyr, 1981), United Kingdom (Treacher et al., 1987) and Cyprus (Hadjipanayiotou et al., 1988) have shown that goats have greater growth potential, and in some instances growth rates similar to lambs may be obtained. Preweaning growth rates above 200 g/day were obtained in the studies of Fehr et al. (1976), but after weaning at 42 days of age, gains were significantly reduced. Experience gained in Cyprus however, showed that postweaning growth rate of Damascus kids offered concentrates (18% crude protein) ad libitum along with 100 g of alfalfa hay per head daily is not lower than preweaning growth rates. It must be underlined however, that pre-and postweaning growth rates are greatly affected by feeding and managerial practices.

## Feed conversion

Feed conversion (kg feed dry matter per kg body-weight gain or carcass gain) is a function of feed composition, level of feed intake relative to maintenance requirements and body composition. Feed conversion improved with successive substitution of concentrate for roughage (Naude and Hofmeyer, 1981). Early data showed that fattening kids are less efficient than lambs. In relatively recent studies however, with Damascus (Hadjipanayiotou, 1982; Hadjipanayiotou et al., 1988) Boer (Naude and Hofmeyr, 1981) Norwegian (Skjevdal, 1974 cited by Naude and Hofmeyr, 1981), Alpine (Fehr et al. 1976) and British Saanen (Treacher et al., 1987) kids, where higher growth rates (160 to 280 g/day) were obtained, feed conversion ratios comparable to those obtained in lambs were attained.

Feed conversion decreases with increasing slaughter weight. However, due to the initial high investment for the purchase of the stock, the relatively small quantities of feed required per kg body weight gain (Tables 2 & 3) and provided that the cost of feed required is less than the income from the extra meat produced, it is desirable to extend fattening of kids up to 60-70 % of their mature body size.

TABLE 3.

The effect of fish meal (FM) and of formaldehyde (HCHO) treatment of soybean meal (SB) (FSB) on the performance of Chios male lambs and Damascus kids.

| | Concentrate mixture | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Soya (SB) | | HCHO SB (FSB) | | Fish meal (FM) + SB (FMSB) | | FM + FSB | |
| Species | L | K | L | K | L | K | L | K |
| No. of animals | 32 | 18 | 13 | 10 | 33 | 18 | 13 | 10 |
| Daily weight gain(g) | 353 | 275 | 348 | 300 | 352 | 317 | 364 | 318 |
| Feed intake (g/day) | | | | | | | | |
| Concentrate | 1216 | 1113 | 1078 | 1124 | 1214 | 1085 | 1168 | 1040 |
| Concentrates+hay | 1316 | 1213 | 1178 | 1224 | 1314 | 1184 | 1268 | 1140 |
| Feed / gain ratio | | | | | | | | |
| Concentrates | 3.65 | 4.06 | 3.62 | 3.75 | 3.64 | 3.44 | 3.80 | 3.27 |
| Concentrates+hay | 4.09 | 4.14 | 3.90 | 4.08 | 3.97 | 3.49 | 4.07 | 3.58 |

L = lambs, K = kids

**Nitrogen Nutrition of Fattening kids**

In a semi-intensive/intensive kid fattening system where good quality feedstuffs of high palatability are used, protein is of the greatest importance in most practical situations. Research work conducted in Cyprus showed that early weaned male Damascus kids on high concentrate diets offered ad libitum, respond to increasing dietary protein concentration only up to 180g CP/kg DM (Louca and Hancock, 1977; Mavrogenis et al., 1979; Hadjipanayiotou, 1982).

Feeding kids formaldehyde treated groundnut cake resulted in higher growth rates and better feed conversion efficiencies compared to the control (Mudgal and Sengar, 1981). Contrary, in our studies (M. Hadjipanayiotou, unpublished data) protection of soybean with formaldehyde did not improve daily body weight gain and/or feed to gain ratio in either early weaned lambs or kids offered concentrates ad libitum along with 100g of lucerne hay (Table 3). On the other hand, the presence of fish meal (69 kg/T concentrate) in the concentrate mixture resulted in a significant improvement of liveweight gain and feed to gain ratio in kids but not in lambs. Differences between species

obtained in our studies can be partly ascribed to the higher nitrogen requirements of kids than lambs and possibly to differences in amino acid requirements between the two species.

**Ionophores in kid fattening rations**

Ionophores have been used in a number of experiments with kids conducted in Cyprus (Hadjipanayiotou et al., 1988), Egypt (Mehrez et al., 1982) and USA (Beede et al., 1985). Addition of lasalocid sodium (37 mg/kg concentrate mixture) improved final weight and daily bodyweight gain and feed efficiency of kids on high concentrate diets (Hadjipanayiotou et al., 1988). Lasalocid sodium reduced coccidiosis in kids (Hadjipanayiotou et al., 1988 and Antoniou and Christofides, 1983). Both monensin and lasalocid sodium have been cleared for use in cattle in Europe and the USA. In view of the remarkable response to lasalocid in kids but not in lambs on high concentrate diets (S. Economides et al., unpublished data) it seems safe to conclude that addition of monensin or lasalocid sodium in diets of semi-intensively fed kids will improve performance and consequently the economics of kid fattening operations.

**Castration**

Abundant experimental evidence on sheep, cattle and pigs (Turton, 1962) shows that castration of males generally results in decreased growth rate, poorer feed conversion efficiency and fatter carcasses. Intact male Damascus kids grew faster and used feed more efficiently than castrates until they were about 9 months old (Louca et al., 1977). Early castrates produced fatter carcasses than those of intact kids. Castration at older ages (approx. 7.5 months) resulted in a very poor growth and the operation caused a serious check in growth.

A taint of varying intensity was present in the meat of intact goats but not in that of early (7 days of age) or late (7.5 months of age) castrates. It must be underlined however, that under intensive conditions growth rate is fast and male kids slaughtered before the need for castration arises. Castration has been used by Morand-Fehr et al., (1985) to improve carcass quality of Alpine kids. Castration increased the fattening score of kid carcasses (4.31 vs 3.94 for intact kids) and the weight of adipose tissue. In the same studies however, castration reduced growth rate (228 vs 272 g/day), and the authors concluded that the most efficient way to improve kid carcass quality is to increase slaughter weight.

## HEALTH CARE

Intensification of production brings along new problems and producers have to acquainted with the risk involved in order to control and prevent them, as prevention is the best medicine.

A producer of a kid fattening operation must be aware of possible risks from white muscle disease, enterotoxaemia, external and internal parasites and other diseases which might adversely affect animal performance. In addition, nutritional disorders (urolithiasis, go off feed etc) associated with sudden feed changes, high concentrate feeding and unbalanced diets, should be taken into consideration.

## GOAT MEAT CHARACTERISTICS

Goat meat compares very favourably with other meats; it has a high protein and low calorie content. Haenlein (1986) postulated that such composition also suggests favourable production economics because it is cheaper nutritionally to produce lean.

When compared at the same empty body weight, there was no effect of dietary protein concentration (11.3, 16.0 and 20.9% CP) on the composition of the empty body of cashmere goat (Ash and Norton, 1987). In the same study however, ad libitum feeding resulted in significantly more fat and less water in the body compared with the restricted (75% ad libitum) feeding regime.

Overall lambs on similar feed appear to lay on more fat than goats. However, fat distribution is such that a greater portion of the fat of lamb carcasses will be accepted by consumers. Lambs deposit more subcutaneous fat, but goats are higher in deposits of visceral fat (McDowell and Bove, 1977).

Body composition changes as animal grow older and heavier. Carcass weight comprises an increasing proportion of body weight. These relationships are shown in the study of S. Economides (unpublished data) where cold carcass weight and weight of intestinal and kidney-fat as a percentage of slaughter weight were increased (Table 4).

The effect of castration on carcass composition has been discussed in the relevant section. Slaughter and dissection data of Damascus kids offered concentrates ad libitum are shown in table 5.

TABLE 4.

The conversion of milk or solid feed to kid carcass from birth to 40 kg live weight.

| | Slaughtered at | | | | | |
|---|---|---|---|---|---|---|
| | Birth | Weaning | 25 kg | 30 kg | 35 kg | 40 kg |
| No. of animals | 10 | 5 | 5 | 5 | 5 | 5 |
| Live weight at slaughter (kg) | 4.2 | 15.5 | 25.0 | 30.0 | 35.0 | 40.0 |
| Age at slaughter(days) | 2 | 52 | 93 | 115 | 130 | 151 |
| Cold carcass weight (kg) (IS) | 1.85 | 8.0 | 11.5 | 14.5 | 17.5 | 20.0 |
| Cold carcass weight (kg) (CYS) | 2.40 | 9.7 | 14.0 | 17.4 | 20.7 | 23.8 |
| Kg of milk/kg carcass gain (IS) | -- | 12.8 | -- | -- | -- | --- |
| Kg of milk/kg carcass gain (CYS) | -- | 11.0 | -- | -- | -- | --- |
| Kg of concentrates + hay /kg carcass gain | | | | | | |
| (IS) | -- | -- | 9.0 | 9.1 | 9.0 | 8.9 |
| (CYS) | -- | -- | 7.4 | 7.5 | 7.3 | 7.5 |
| Intestinal fat (g) | | | 185 | 290 | 430 | 720 |
| Kidney fat (g) | | | 48 | 130 | 220 | 300 |

IS = International standards for carcass
CYS = Cyprus standards for carcass (head, lungs, heart and liver included)

TABLE 5.

Slaughter and dissection* data of Damascus kids offered concentrates ad libitum (Louca et al., 1977).

| | Males | Early castrated | Late castrated | SE |
|---|---|---|---|---|
| Liveweight (kg) | 55.0 | 53.5 | 54.0 | 1.39 |
| Dressing percentage | 55.7 | 56.4 | 54.9 | 0.96 |
| Skin (kg) | 6.09 | 3.97 | 4.79 | 0.25 |
| Head (kg) | 1.87 | 1.69 | 1.87 | 0.08 |
| Kidney fat (kg) | 0.98 | 1.65 | 0.91 | 0.24 |
| Muscle / fat ratio | 1.53 | 1.08 | 1.28 | 0.11 |

* Two chops (12$^{th}$ and 13$^{th}$ vertebrae) from each of the half carcasses were dissected into bone, fat and muscle.

## CONCLUSIONS

Semi-intensive kid fattening system can be justified when there is high demand and good price for kid meat, scarcity of nutrients quantitatively and qualitatively, overstocking of grazing lands, relative low price of alternative mixed feeds and restriction in feed uptake imposed by poor quality feedstuffs. The great role of nutrition (feeding of balanced diets in terms of energy, protein and macro-microminerals and vitamins, feed preparation, feed additives), breeding (selection of fast growing animals), management, and animal's health as a means to improve economics in semi-intensive systems is widely accepted.

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# STRATIFICATION OF SMALL RUMINANTS PRODUCTION SYSTEMS

E.S.E. GALAL

Department of Animal Production, Faculty of Agriculture, Ain Shams University, Shubra Al-Khaima, Cairo, Egypt.

## ABSTRACT

Stratification systems use mainly crossbreeding to bridge the gap between poor low-priced land and the good high-priced land. Genotypes used/produced are suited to and maximize production from the particular environments. Stratification systems can have wide range of applications in livestock production.

The paper reviews stratification systems in some sheep producing countries. It discusses possible models for stratification systems to combine lamb/kid and milk production in both sheep and goats under arid or semi-arid conditions.

## INTRODUCTION

Stratification of a livestock production system is dividing up the system into layers, in time or space, where each layer specializes in a certain product or a step of production in order to maximize the utilization of resources. Due to the numerous sheep breeds available and the varied environments in which they can live the concept of stratification in sheep production has long been in practice. However, in goats no systematic stratification has been recorded.

Within a purebreeding structure a stratification could mean dividing the breed population into stud breeders, multipliers and producers. This aspect of stratification is not the aim of this presentation.

The objectives of this paper is to review current production-systems stratification in small ruminants, propose possible ones and examine a simulation study of different stratification systems using the Egyptian Barki sheep breed as the basic population.

## CURRENT STRATIFICATION SYSTEMS IN SHEEP

Stratification systems discussed below are based on geography and land use (Lerner and Donald, 1966) and crossbreeding is used to bridge the gap between the poor low-priced land to the good high-priced land (Hammond, 1960 and Nichols, 1957).

The main concept in all these systems is that ewes from a basic population, whose animals are hardy and well adapted to less favorable conditions but less productive, are mated to rams from higher producing breeds. Crossbred lambs are transferred to better environments either to be prepared for slaughter or to be used for breeding in more favorable environments. In the U.K. for example altitude provides from high to low, rainfall, high to low; temperature, extreme to equable; poor natural pasture grazing to intensive grazing; slow to rapid growth; poor mutton to good mutton to lamb; slow to rapid capital turnover and low to high land values. Stratification systems usually goes beyond genetic considerations. The utilization of F1 ewes, e.g., does not presuppose the presence of heterosis or maternal effect but the main prerequisites are the economic use for such ewes and the willingness of producers to integrate into the system (Nitter, 1978).

### United Kingdom

Ewes from hill sheep noted for their hardiness and suitability to harsh conditions, e.g. Cheviot, Blackfaced Welsh and Swaledale, are mated to rams of more early maturing, higher fertility and high milk producing breeds, e.g. Border Leicester. Male lambs produced are sold for meat production while female lambs are sent to the stratum with good pasture land to be mated to rams from the still faster growing, earlier maturing down breeds, e.g. Suffolk or Southdown, to produce progeny sold as fat lamb. This stratification proceeds from high altitude and relatively poor environments to lower altitude with relatively higher value land and more favorable environment (Nichols, 1957).

### Australia

The Merino is the basic stock. The cull Merino ewes of the semi-arid and arid ranges are taken to the wheat belt and crossed with Border Leicester, Romney or Dorset Horn rams. The males are sold for slaughter while the females are sent to the subterranean clover or irrigated areas to be mated with Southdown rams for the production of fat lamb (Hammond, 1960).

**New Zealand**

In the North Island, where the rain fall is too heavy for the Merino or breeds with high composition of it, e.g. Corriedale, the basic stock is the Romney. Cull Romney ewes are sent to the rich pastures of the dairy districts of North Island or the agricultural Canterburry plains of South Island where they are mated to Southdown rams or any other down breed to produce fat lamb (Epestein, 1965).

In South Island the basic stocks are the Merino and Corriedale kept in the mountains on the unfavorable native pastures. Cull and surplus ewes are sent to lower elevations to be mated to rams from longwool breeds, e.g. Romney, Border Leicester or Lincoln. The half-bred ewes are taken to the plains and farm areas to be bred to Southdown rams for fat lamb production.

**United States**

The basic stocks are generally fine wool breeds, i.e. Merino or Rambouillet raised on poorer ranges. Ewes from these stocks are mated to rams from faster growing breeds, e.g. Lincoln. Male lambs are sold for slaughter while the females are bred to rams from down breeds, e.g. Hampshire or Suffolk, under more favorable conditions and the resulting lambs are sold for fat lamb production.

Prolific breeds, e.g. Finnish Landrace or Romanov are entered into these stratified systems for more intensive lamb production.

## PROPOSED MODELS FOR STRATIFICATION SYSTEMS FOR MEAT AND MILK PRODUCTION IN NEAR EAST

Sheep stratified production systems are followed in countries where the animal industry has matured and acquired recognized features. Producers operating such systems are sophisticated and have a degree of awareness of the market and the economics of production. These might be impediments against the wide application of stratification or the concept of it in the Near East but some producers in the region have the necessary prerequisites to operate such system.

Most sheep in the Near East are raised under range conditions where the breeds are well adapted to the harsh conditions. Lambs are either marketed immature off the range, at yearling age after they have added some weight or after a period of fattening. Examples for these breeds are

the Barbari of North Africa, the Barki of Egypt and Awassi of East Mediterranean. The stratification models discussed below would use these breeds as the basics stock and integrate their meager environment into more favorable environments.

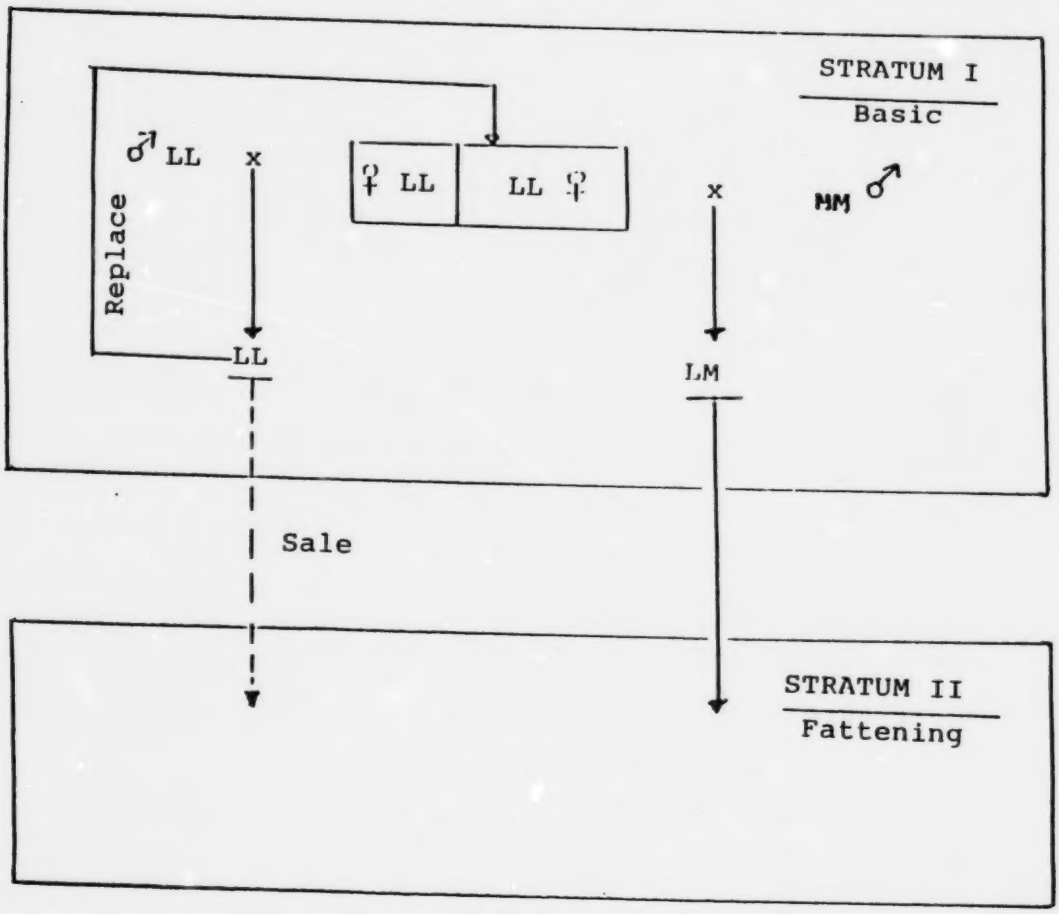
Meat production. The simplest system is where part of the ewes from the basic stock (B) is mated to rams from the same breed to produce replacements and the rest is mated to rams from an earlier maturing faster growing Mutton breed (M), e.g. Suffolk. This step takes place at the range (stratum 1). Surplus B lambs and all crossbred lambs are sent to stratum 2, near consumption centers, for fattening on irrigated pastures, dry feeding or both (Figure 1). This model may be further developed by first mating B ewes to rams from prolific breeds where F1 ewes are sent to stratum 2 to be mated to M ram. Surplus B lambs and all F1 male lams and all M.FB lambs are sent to stratum 3 for fattening.

Meat and milk production. Morag (1972) and Gall (1975) discussed a stratified system for meat and milk production. This system is operated in three strata. The basic (stratum 1) is where B ewes are partly mated to B rams to produce replacements and partly to rams from a dairy breed (D), e.g. East Friesian or Improved Awassi. F1 ewes (DB) are sent to stratum 2 for production to be mated to M rams to produce M.DB. Surplus B lambs, all DB male lambs and all M.DB. lambs are sent to stratum 3 for fattening (Figure 2).

## Goats

Gall (1981) suggested dividing the female herd into dry does on range grazing and lactating does on more intensive feeding, and rotating them as their physiological state changed. Goats have been widely thought of as inefficient in fattening, produce low quality carcasses and have little scope for intensification due relatively high cost and the variable demand on their products. However, with more information being available on goat germ-plasm and the solid demand on goat meat in some countries, e.g. West Africa, this picture may change. Skinner (1972), in South Africa, reported a successful example of extensively managing the Boer does, kidding twice a year on the range while intensively fattening their kids. The Boer goat is characterized by a high average daily gain for kids (250-291 g and 180-272 g for males and females, respectively, Naude and Haufmeyer, 1981) and feed conversion rate as low as 3.9 in the kids.

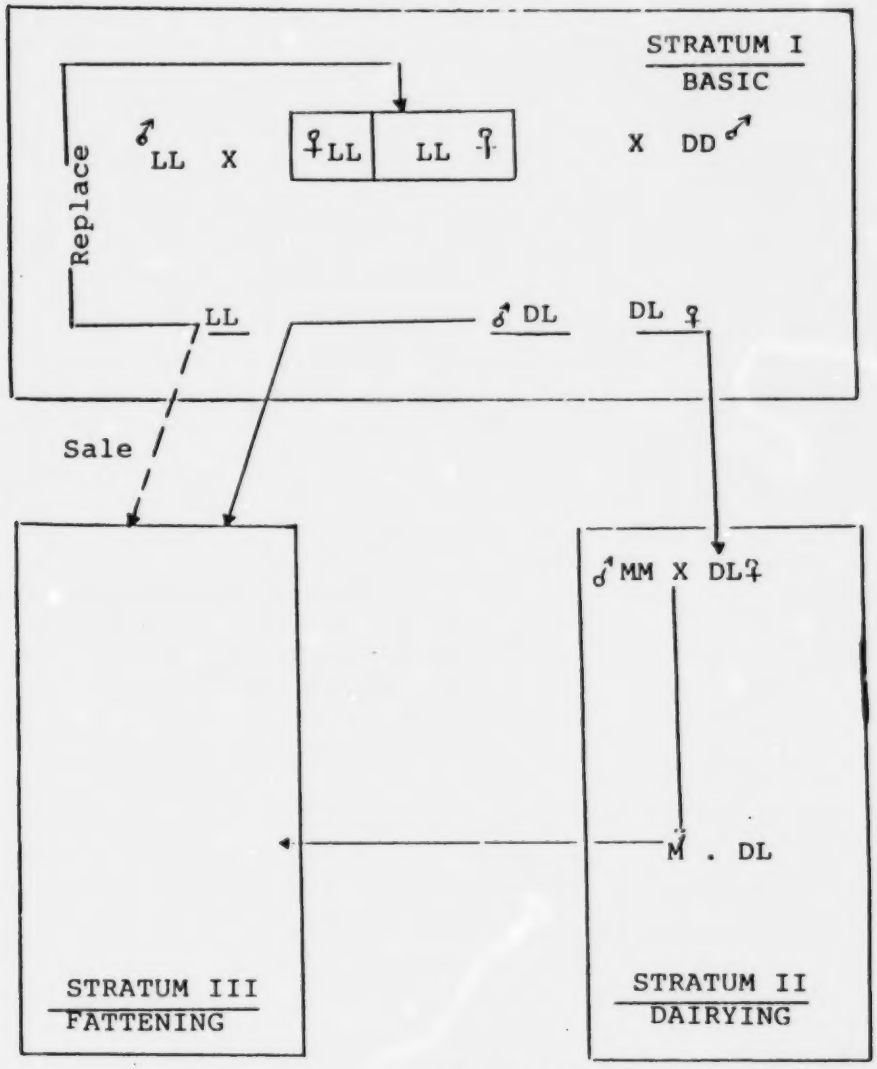
Flamant and Morand-Fehr (1982) cited an experience in stratified system in goat production in Corsica. Strata




L : Local extensive

M : Meat

**Figure 1.** Mutton production stratification System.




L : Local extensive
D : Dairy

Figure 2. Mutton and dairy production stratification System.

ranged from one with zero input and local breeds to three with intensified inputs including specialized dairy breeds. Although stratum one was biologically the least efficient it was economically more favorable because of the low level of inputs.

With the emerging recognition of meat type breeds like the Boer goats similar stratified systems, either for meat production, dairy production, or for meat and dairy production, as those for sheep may be proposed in the same manner as above (Galal, 1987). An excellent dairy goat (D) breed from the region is the Damascus. It may be used in a stratified system for dairy production by mating B does partly to B bucks to produce replacement and partly to D to produce F1 kids in stratum 1. Surplus B kids and all F1 male kids are sold for slaughter while female F1's are sent to stratum 2 for dairying. Stratified system for meat production in goats will not require the extra step in sheep to introduce high prolificacy since most goat breeds are quite prolific.

## A SIMULATION STUDY ON STRATIFICATION IN EGYPTIAN BARKI SHEEP

A study was made on a commercial Barki flock kept on a newly reclaimed land on the fringes of the desert to evaluate the performance of the flock and the economics of the system. The study was extended to hypothetical, but possible, systems of intensifying lamb production through integrated varied environments and crossbreeding by simulation. The main sources for biological coefficients used were the basic study on the Barki flock and other pertinent experiments made in Egypt.

Three systems were examined.

1. Purebreeding. Results on this system are actual. They serve as a control for the other two systems.
2. Two strata crossbreeding. The basic stratum of Barki ewes is divided into two parts, one mated to Barki rams to produce replacements and the other mated to rams from a mutton breed to produce market lambs that are sent to stratum 2 for fattening.
3. Three strata crossbreeding. The basic stratum is the Barki flock where a part of the ewes are mated to Barki rams for replacements and the other part mated to rams from prolific sheep, e.g. Finnish Landrace or Romanov. F1 male lambs are sent to stratum 3 for fattening while F1 females are sent to stratum 2 to be mated to a terminal sire from a mutton sheep, e.g. Suffolk. All 3-way cross lambs are fattened in stratum 3.

All three systems were examined when their flock structure became stable. Biological coefficients varied with the system were:

- live weights/growth rate
- conception rate
- litter size
- mortality rates

For the lack of reliable estimates feed conversion rate on fattening was kept constant across all genotypes.

Table 1 shows comparisons among the three systems (unpublished results).

TABLE 1

Biological performance of the three systems.

| Criteria | System | | |
|---|---|---|---|
| | 1[a] | 2[b] | 3[c] |
| No. of lambs weaned/ewe joined | 0.628 | 0.628 | 0.74 |
| kg of lambs weaned/ewe joined | 11.53 | 12.09 | 14.46 |
| No. of lambs marketed/ewe joined | 0.36 | 0.37 | 0.47 |
| kg of lambs marketed/ewe joined | 13.50 | 15.15 | 19.54 |
| kg of lambs marketed/kg ewe joined | 0.386 | 0.433 | 0.436 |

[a] Purebreeding Barki
[b] Two strata crossbreeding, basic stratum Barki and terminal sire Suffolk.
[c] Three strata crossbreeding, basic stratum Barki, stratum 2 first cross ewes between Finn rams and Barki ewes, F1 ewes mated to terminal Suffolk rams, stratum 3 for fattening when flock reaches full use of $F_1$ ewes (730 ewes).

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# GOAT PRODUCTION IN SMALL FARM SYSTEMS

C. DEVENDRA

Division of agriculture, food and nutrition sciences,
International Development Research Centre, Tanglin P O Box 101
Singapore 9124

## ABSTRACT

The paper discusses the importance of goats in small farms within the prevailing production systems (system combining arable cropping and systems integrated with tree cropping). Reference is made to the definition of small farms and small farmers and their characteristics. The significance of ownership is associated with economic, managerial and biological advantages which are reflected in such advantages inter alia as : income, food production, security, employment, fertilizer, by-product utilization, bush control, leather trade and handicraft, fibre, social values, recreation and transportation. Case studies on the extent of the economic contribution from goats are cited in Indonesia, Pakistan, India, China and Africa. The value of the economic contribution is especially important in arid and semi-arid regions where goat rearing is often the main vocation, and means of survival for nomadic and transhumant people, compared to the humid tropics where its production is usually a sub-system within the main crop-based farming system. Particular focus is made on the role and contribution of women and children in the management of goats. The opportunities for overcoming the constraints, especially management problems, and the significance of these on increased productivity from the species, sustainability and improved human welfare of small farmers are emphasized.

## INTRODUCTION

Goat constitute important animal in small farm systems in the developing countries. This importance is related to their varied role and size of the herd, relative proportion to other animals if any, scale and intensity of production. These aspects are closely associated with distinct socio-economic contribution to several millions of poor farmers, landless peasants and laborers to whom ownership of

goats provides a definite means of livelihood and its sustainability (Devendra, 1980).

In situation where the land is of poor quality and is marginal, crop cultivation is often difficult, rarely intensive and constrained by several environmental factors such as rainfall, very high temperature and poor soil fertility. Diversification of the farming system is difficult, but under these circumstances, goats and often sheep rearing together make significant contribution to poor farmers and the stability of small farm systems. This importance and contribution by goats increases with decreasing quality of the land, sustainability of the extensive type of farming system, and is typical of the arid and semi-arid regions of the world. Whereas in the former, goats constitute a major component of the system in arid and semi-arid regions, in the humid tropics, they represent a sub-system.

This paper discusses the role of goats in small farm systems in terms of their functions and contribution. In particular, it will focus on the significance and socio-economic relevance of their ownership to small farmers and poor peasants to whom their ownership is especially important.

## SMALL FARMS AND SMALL FARMERS

The small size of the holdings is one of the characteristics of small farm systems. The actual size varies between regions and between countries. Table 1 sets out the distribution of small ruminants in selected developing countries in relation to the size of holding. About 64% of the goats in Asia are kept on 5 ha of land or less compared to 48% in Africa and 39% in North, Central and South America. The distribution of goats parallels that for sheep. These figures emphasize that the concentration of ruminants is highest in small holdings and is particularly so in Asia.

Small farmers, including landless laborers and low income tenants are peasants who are usually crop-oriented. They are essentially poor people who face geographic isolation. They continuously experience hunger and rural poverty, and probably because of this, have the capacity to adapt and access and inability to use new technology. Being illiterate, the majority are not interested in extension materials. They provide the family labour depending on the scale and magnitude of the farm operations and livestock production. They shepherd or tether their animals. Children are often used for herding small ruminants. Landless

agricultural laborers provide surplus labour which is of added value to the most progressive farms (Devendra, 1983a).

The village is the focal point of all forms of activities, mainly agricultural, economic and cultural. It is variable in size with respect to the number of households, ranging from a few hundred such as in parts of South East Asia, to several thousands in a cluster in West Africa. The village economy is based on crop production, primarily to meet the subsistence needs of the peasants but also to provide some cash. The crops grown are varied, but cereals (maize, rice and wheat), and root crops (cassava, sweet potatoes and yams) are important staple foods in most developing countries.

TABLE 1

Distribution of Animals By size of Holding in the Developing countries by region (FAO, 1981).

| Region | Total No. of animals ($10^6$) | Holdings without land[2] ($10^6$) | % distribution | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Under 1 ha | 1-5 ha | 5-20 ha | 20-100 ha | 100-500 ha | 500 ha |
| I. Goats | | | | | | | | |
| Africa (4)[1] | 1.8 | 309.7 | 9.9 | 38.5 | 38.6 | 11.9 | 0.8 | 0.3 |
| N & C America(2) | 2.3 | 0.3 | 0.0 | 0.3 | 1.3 | 15.3 | 32.4 | 50.7 |
| South America(4) | 8.9 | 309.3 | 10.4 | 28.3 | 21.1 | 21.6 | 12.6 | 6.0 |
| Asia (5) | 12.6 | 140.5 | 33.6 | 30.7 | 27.8 | 7.5 | 0.3 | 0.1 |
| II. Sheep | | | | | | | | |
| Africa (4) | 4.7 | 194.9 | 4.4 | 20.9 | 43.5 | 26.7 | 4.1 | 0.4 |
| N & C America(3) | 20.6 | 0.1 | 0.0 | 0.1 | 1.2 | 16.0 | 32.9 | 49.7 |
| South America(5) | 50.5 | 4.5 | 5.6 | 9.5 | 7.0 | 9.9 | 17.9 | 50.1 |
| Asia (5) | 13.9 | 662.8 | 19.9 | 26.4 | 37.2 | 13.8 | 2.0 | 0.7 |

[1] No. of reporting countries.
[2] Establishments with no agricultural land which raise livestock and livestock products.

Small ruminants are often preferred over large rum nants. However, the real importance of individual species i dependent on the total population of individual species and al o the extent of their development. Goats and sheep are convenient y cared for by unpaid family labour (woman and children), occupy little housing space and supply both meat

and milk in quant ties suitable for immediate family consumption. Their pot ntial value in less developed countries has been emphasized (Dev–ndra, 1980). In Latin America, the importance of small animals over large animals in small farms is being advocated in order to alleviate the serious economic and nutritional predicament of small farmers and their families (Huss, 1982).

In mixed crop-animal systems typical of the humid tropics in several countries in South East Asia, East and West Africa, Central America and the Caribbean, one or more species of animals are reared on the farms. There usually exists several species of animal within prevailing mixed farming operations in small farms : buffaloes, cattle, goats, sheep, poultry, pigs, ducks, quails and rabbits but, seldom are all these animals maintained together.

**SIGNIFICANCE OF OWNERSHIP**

Ownership of goats in small farm systems has considerable significance. It is associated with several objectives to serve the material, cultural and recreational needs of the farmers as follows :

(i) Income - important means of earning supplementary income.
(ii) Food - provide animal proteins (milk and meat) that are important for the nutritional well-being of peasants.
(iii) Security - sources of investment, security and stability.
(iv) Employment - creation of employment including effective utilization of unpaid family labour.
(v) Fertilizer - contribution to farm fertility by the return of dung and urine.
(vi) By-product utilization - they enable economic utilization of nonmarketable crop residues.
(vii) Bush control and clearance - in many parts of Africa, goats are used to control and clear the bush. The task is also facilitated by many goat breeds being tryponotolerant.
(viii) Leather trade and handicraft - skins are used extensively to produce various leather goods and handicraft.
(ix) Fibre - Mohair and cashmere are very important fibers in the textile trade and are highly sought after. Ordinary goat hair also has commercial value.
(x) Social values - the ownership of animals has been shown to increase cohesiveness in village activities.

(xi) Recreation - socio-economic impact of animal ownership also includes a recreational contribution to small farmers.

(xii) Transportation - in highland areas such as in the Himalayas, goats provide means of transporting small loads.

The significance of ownership becomes much more important in arid and semi-arid environments. Goats have particular ability to resist dehydration and adapt to drought conditions (Devendra, 1987a; 1987b). In addition, they reproduce more efficiently. These attributes result in their increased ownership by nomads and transhumant families especially in harsh environments.

The relatively small size of goats is a distinct advantage in the complexity of small farm systems. There are definite economic, managerial and biological advantages as follows :

(a) Economic - low individual values means a small initial investment and correspondingly small risk of loss by individual deaths. This makes goats and other sheep an attractive proposition for household use and subsistence farming, especially for poor families.

(b) Managerial - goats can conveniently be cared for by women and children, occupy little housing space, and supply both meat and milk in quantities suitable for immediate family consumption, which is important in view of the difficulties of storage in the tropics.

(c) Biological - one or two goats can be kept when nutrition is inadequate for even one cow.

The milk producing ability of dairy goats represents the most important function especially in comparison to sheep. Lactating goats have a high persistency in milk production, and this is significant to the daily nutrition of especially pregnant and nursing mothers and children. One liter of milk produces approximately 32 g of proteins which provides about 46 g (70%) of the daily requirements of a lactating or pregnant mother, but is adequate for the daily needs of a child up to 11 years of age. The supply of 1.7 g / litter of Ca is adequate to meet daily requirements.

## ECONOMIC IMPORTANCE

Rearing goats and often sheep together offers a very important means to generate income as well as sustain both the rural households and farming operations. Some examples from individual country situations serve to demonstrate this point.

(i) Indonesia

A study by Knipscheer et al. (1983) indicated that the involvement of rural households in West Java in raising small ruminants is large. One out of every five farmers kept sheep or goats, and participation by farmers was as high as 30%. The contribution of goats and sheep to the total farming income is substantial and was about 14, 17 and 26% for the lowland, upland and rubber plantation situations, respectively. The report also indicated that the income share of the small ruminant enterprise increased as the farmer's resource base, especially land, decreased.

(ii) Pakistan

The second study concerns the income to be derived from the transhumant system of rearing goats and sheep by a landless family utilizing crop residues. Sale of wood plus sheep accounted for 51.4% whereas the sale of goats plus milk accounted for 43.9% of the annual income. About 56% of the value of family consumption was in the form of milk. The net family income was 2620 PRS. equivalent to about US $ 291, about half of which was cash income (McDowell, 1976). This study confirms the results of an earlier study (Wahid, 1965), which reported that goats contributed about 20-40% to the total cash income, and in the most remote parts the contribution was as much as 50%. The income from goats contributes significantly to their livelihood.

(iii) India

In Andhra Pradesh, for example, calculations on the returns from keeping goats suggest that this is very profitable (Sriramaimurthy, 1977). In Rajasthan, Jodha (1966) has reported that based on a 5-year analysis, the net annual income from keeping goats and sheep of a semi-nomadic family was 1600 Rs. The main component of this income was the sale of wood and animals. Results of a survey on the economics of feeding and rearing practices of goats and sheep in the hilly regions of Himachal Pradesh indicated that for the migratory and stationary systems, incomes generated as a percentage of total cost of production were 11.8-72.7% and 23.5-32.4%. The corresponding values of sheep were 9.4-25.6% and 10.0-16.9% (Raut and Nadkarni, 1974). Labour was the main cost component in all systems and this was much higher in the stationary system compared to the migratory system.

More recently, Singh and Ram (1987) have reported data on the economic analyses of rearing goats in the submontane and plains of Punjab. The contribution of income from milk to

total income increased with herd size from 66.64 to 73.63 % and from 72.97 to 80.46% in the two areas, with total income per goat decreasing from Rs. 414.75 to 354.39 and from Rs. 685.89 to 400.56, respectively. Annual income per household, taking all factors into account except interest on capital and costs of family labour, averaged Rs. 2275 .2, 3796.3 and 9327.0 for small, medium and large herds in the submontane area and Rs. 4460.5, 6773.3 and 9922.9 in the plains.

(iv) China

In intensively cultivated upland areas in the Sichuan province involving wheat-barley-rape-rice cropping systems where also pigs and goats are often reared by farmers, it has been estimated that the pigs contributed 19% and goats 10%. Goats in particular, were associated with poor people.

(v) Africa

Wilson (1986) has reported that almost all the small ruminants and in which goats were predominant, were found in the agro-pastoral systems. Within the systems and in those associated with subsistence rainfed agriculture, irrigated or cash crop rainfed agriculture, the contribution by small ruminants to the total revenue were 25, 15 and 10%, respectively.

**THE ROLE OF WOMEN AND CHILDREN**

The role of women and children in the management of goats in integrated village systems represents one of the unique features of the systems. This is often an under-estimated issue, but their contribution to goat rearing, and the benefits of this to the stability of small farm systems and the household is very much more than is realized.

The management of goats and sheep, especially small flocks in village systems is more the purview of women than that of men. This is the case in the altiplano regions of Latin America, most sub-Saharan countries, the Indian sub-continent and South East Asia. In South and South East Asia, women take care of goats and or sheep and often own them. In upper Volta, Mossi, Fulani and Rimable women own goats and consider them an investment, Mossi women in particular view them as an insurance against famine (Safilios-Rothschild, 1983). In Mali, a survey of five villages among the Marka, Peulh Rimaibe and Cuerga ethnic groups showed that goats and sheep were mostly owned by women either through inheritance from their mothers, or through purchase with income from selling agricultural produce. Ownership represents prestige and security to the

women in case of divorce or seasonal immigration of the husband and allows them to meet family and social obligations such as in the purchase of clothes, care of sick children and coremonial costs (Safilios-Rotchild, 1983). Although women often own the goats, husbands participate in the decision to sell, and among the poor farmers of the Peruvian Altiplano, only men can sell the animals (Deere and Leon de Leal, 1982).

Survey results in West Java, Indonesia, indicate that participation by family members was quite significant. Although there were locational differences, women and children had an important influence on the management of goats (Muljadi, Knipscheer and Mathius, 1984). the women's share of involvement in rearing small ruminants increased with increasing number of animals reared. Additionally, literate women were more involved in the physical activities of management (herding, grass cutting, feeding, watering and health control) than in decision making (planning and marketing) probably because of their perception for the animal's needs. Illiterate women by comparison, involved their husbands in all activities (Wahyuni, Suradisastra and Juarni, 1983; Wahyuni, Gaylord and Knipscheer, 1985).

In East Africa in many pastoral systems such as in Kenya and Ethiopia, women have the disposal rights of milk. Women make the decision concerning the timing and quantity of the milk sold, the revenue from which are then available to them for appropriate use in a variety of ways to meet especially the needs of the family. In intensively cropped mixed farm situations in China such as Xian, improved Saanen goats are managed by women and children. In one particular village situation which had 40 families, 29 of these reared goats. The goats were milked three times daily and most of the milk produced was used for home consumption and also sold as yoghurt.

**MANAGEMENT OF GOATS**

The management of goats in small systems are closely associated with the type of production system. These are broadly of two categories and have been described (Devendra, 1986a) :

A. Systems combining arable cropping

(i) Roadside, communal and arable grazing systems
(ii) Tethering, and
(iii) Cut-and-carry feeding

B. Systems integrated with tree cropping

The feeding management consists mainly of grazing, feeding of any cut fodder and the occasional use of crop residues and agro-industrial by-products produced in the farm. Very seldom are purchased concentrates fed. These are in any case not really necessary for meat production, which is the main production objective throughout the tropics. Kitchen wastes is the main production objective throughout the tropics. Kitchen wastes and remnants, including salt and water are however, extensively fed to goats in the village system. Probably because of this and especially with systems involved with arable cropping the goats tend to congregate near the homesteads in the villages.

A variety of tree leaves are usually fed to goats, and the most common ones are banyan (Ficus bengalensis) cassava (Manihot esculenta Crantz), jackfruit (Artocarpus heterophyllus), gliricida (Gliricidia maculata), leucaena (Leucaena leucocephala), pigeon pea (Cajanus cajan) and sesbania (Sesbania grandiflora). These proteinaceous forages supply a valuable source of dietary protein, minerals and vitamins; provide variety in the diet and have a significant effect on performance. Their value especially for goats has been emphasized (Devendra, 1983b), and their efficient utilization represents an important feeding strategy in the developing countries (Devendra, 1986b).

## MANAGEMENT PROBLEMS

There are a variety of management problems on small farms. A number of these are major ones and refer especially to breeding methods, feeding systems and animal health measures. With breeding, the ownership of small number of goats precludes the availability of a buck so that mating does at the right time becomes a major problem, especially also if the farmer is busy with crop cultivation. With larger flocks, bucks are usually part of the herd.

Problems of annual feed shortages and consequent low productivity are normal in many parts of the developing countries, and the basic issue is how to improve this deficit situation. Where land is limiting, increased fodder production becomes a problem. The basic strategy is to ensure a feed supply that can be sustained on a year round basis, which means complete use of the total feed resource base. This includes use of available grazing (native and cultivated), cultivated forages including legumes, crop residues, agro-industrial by-products and non-conventional feeds. Conservation measures are important especially if

there are chronic drought periods, including the use of strategic supplements of energy, protein, minerals and vitamins in feeding systems that are cost effective.

In integrated systems, the wider use of agro-forestry systems with complementary advantages of forage production, supply of fuelwood, improvement of soil fertility and permanent soil cover and economic land use are worthy of consideration. A very good example in this context concerns the use of L. leucocephala.

Poor husbandry practices drastically reduce the response from goats and therefore their productivity. Conversely, the effects of improved feeding and management on performance are spectacular and is seen in the results reported for goats in Malaysia (Devendra, 1979) and in India (Sachdeva et al., 1979; Parthasarathy, Singh and Rawat, 1983). In Fiji, improved husbandry, feeding, disease control and breeding has been shown to increase the annual rate of reproduction from 120 to 180% and well fed does to produce their first kid in 12-13 months age (Hussain et al., 1983).

Goats appear to be more susceptible to gastrointestinal parasitism than sheep. In Bangladesh, for example, 82.2% of 214 kids born died within six months of age, of which respiratory disorders, gastrointestinal parasitism and contagious ecthyma where the main causes. In adults, 47.8% mortality was recorded for gastrointestinal parasitism and respiratory disorders (Abdur Rahman, Ahmad and Mia, 1976). Likewise in Sri Lanka, kid mortality from 2340 pregnancies was reported to be 28% (Ranatunga, 1971).

## OVERCOMING THE CONSTRAINTS

Overcoming the constraints necessitate better understanding of the attributes of goats, their role within the farming system and opportunities for increased productivity and contribution from them. The major constraints that affect current productivity need to be given priority, and once identified, thoroughly investigated in terms of how potential improvements are likely to influence greater performance. The final step in this effort is to extend the technology so developed gradually and in a manner that it will be acceptable to small farmers. Acceptable technologies are those that are simple, practical, within the farmer's resource capacity, convincing and consistently reproducible.

In many situations, the non-genetic factors require urgent attention. Among these, particular emphasis needs to be given to feeding and management as these are generally very

inefficient in all developing countries without exception, and result in immediate improved performance. In the Near East region likewise, similar opportunities exist in cognizance of a generally low level of flock performance in extensive systems (Table 2). These average figures suggest that with improved and more intensive systems of management, it is feasible to substantially improve the level of performance of goats.

TABLE 2

Estimated average flock performance under extensive systems in the Near East Region (Devendra, 1985)

| Trait | Performance | Remarks |
|---|---|---|
| Kidding percentage | 80 - 180 % ) | Depending on rainfall |
| Kid mortality rate | 5 - 40 % ) | and the availability |
| Adult mortality rate | 3 - 15 % ) | of feeds |
| Average carcass weight | 22 kg | (range 20 - 24 kg) |
| Average milk production | 50 - 70 kg | Per lactation |
| Estimated flock offtake | 30 - 40 % | Mainly male kids |

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# IMPROVING SHEEP FEEDING SYSTEMS IN MOROCCO DURING THE STUBBLE GRAZING AND THE FEEDING STRAW PHASES

F. GUESSOUS and O. BENSLIMANE

Department of Animal Production,
Hassan II, Institute of Agronomy and Veterinary Medicine,
B. P. 6202, Rabat Institute, Morocco

## ABSTRACT

Improving sheep nutrition during the end of gestation and beginning of lactation while grazing cereal stubble or feeding straw is the objective of two trials reported here. In trial one, ewes in the last month of pregnancy, grazing wheat stubble (stocking rate of 12 or 24 ewes/ha) were supplemented with concentrate at high or low level (cottonseed meal and barley). Neither stocking rate nor level of supplementation had significant effect on ewe body weight change although higher level of supplementation tended to produce higher body gains. Lamb birth weight also was not affected. In trial 2, male sheep were used to evaluate effect of supplementation and urea treatment on straw digestibility and intake. Thirty animals were randomly divided into 5 lots affected to 5 diets; $D_1$ : untreated straw (S); $D_2$ : S + corn + soybean meal; $D_3$ : S + molasses + urea; $D_4$ : urea treated straw (US); $D_5$ : US + molasses. $D_2$ was formulated to contain 10% CP and 30% concentrate in content. Diets 3 & 5 contained the same amount of molasses. Untreated straw was fed chopped.

During the digestibility measurement period, untreated and treated straws were offered at a level of 30 g DM/kg$\cdot^{75}$ in 4 meals per day. Straw allowance was progressively increased during the intake measurement period. Straw used had a relatively high CP and low NDF contents (respectively, 6.2 and 68.0% DM). When fed alone, straw showed a high digestibility of organic matter (DOM) and intake levels (51.4% and 60.7 g/kg$\cdot^{75}$, respectively). Urea treatment significantly improved DOM (58.9%) but not intake (71.2 g/kg$\cdot^{75}$, $P > 0.05$). Lignocellulose digestibility was also increased. Straw DOM in diets $D_2$ and $D_3$ was not significantly different from $D_1$. Diets showed the same straw digestibility as $D_4$. Intake was high in all diets.

These results suggest that urea treatment has been more

effective to improve straw digestibility than supplementation with energy. Application of such results to gestating and lactating ewes seems to be of great interest.

## INTRODUCTION

Besides the oasis areas where sheep has very particular characteristics, sheep production in Morocco can be classified in two main systems : the pastoral and agro-pastoral systems. Within the pastoral system, sheep feeding depends strongly on range and large movements of herds can occur during the year. At the opposite, the agro-pastoral system is characterized by a limited contribution of range to feed supply. Farming is a major source of feeds and consequently animals tend to remain close to the farm all the year around. Sheep productivity, although low on the national level basis, tends to be somewhat higher in the mixed crop-livestock system than in the pastoral one.

Under the agro-pastoral system which seems to be the most susceptible to intensification in Morocco, the main breeding season starts usually in June at the same time as cereal harvest. Consequently, the first half of gestation occurs while animals are grazing stubble. Lambing happens in fall when stubble grazing and straw are the main components of diet. Straw feeding continues until January-February when forage availability in fallow and pastures starts increasing. Nutritional conditions of both ewe and lamb usually improves during spring.

Within such feeding calender, the period between September and February is obviously the most critical for ewe productivity. It corresponds to the end of gestation and beginning of lactation where nutrient requirements of ewes increase rapidly. It also coincide with the coldest months of the year where poor management conditions and undernutrition can lead to high lamb mortalities. Consequently, research on intensification of sheep production in Morocco has focused on this period with 2 objectives :

1) supplementation of ewes grazing stubble during the end of gestation, and,
2) improvement of straw utilization through urea treatment and / or energy and nitrogen supplementation.

Avoiding animal weight losses during cereal stubble grazing phase has been the main objective of several studies reviewed by Guessous et al. (1988, unpublished). When total

stubble biomass available at beginning of grazing period ranged between 4 and 6 T dry matter DM/ha, sheep liveweight has been maintained during the first 10 to 12 weeks of grazing either by low stocking rates or by supplementing ewes under high stocking rates with both protein and energy sources after the first 4 weeks of grazing.

Straw represents a major component of sheep diet during fall and winter in the agro-pastoral system. Even during the end of gestation and beginning of lactation, straw is usually fed either alone or with small amounts of energy supplements (barley). Consequently, nitrogen is the first limiting factor in diet.

Ammonia treatment has been shown to increase both intake and digestibility of straw by cattle and sheep (Alibes et al., 1984; Sundstol and Coxworth, 1984). However, anhydrous ammonia is not available in many less developed countries and urea has been suggested as an alternative source for $NH_3$ treatment.

## MATERIALS AND METHODS

In order to evaluate effects of urea treatment and / or supplementation on straw nutritive value, hard wheat straw (rectangular bales) was treated with a solution of urea calculated to reach levels of 6% urea (straw DM basis) and 30% humidity. Grinded soybean was added as source of urease at a rate of 1.2% DM. Straw was then hermetically covered with plastic for 78 days during a season where average minimum and maximum temperatures were 6.9 and 17.6° C, respectively (December 86 to February 87). Thirty yearling lambs; 14 months old and 32 kg liveweight were randomly divided in 5 lots and affected to 5 diets : $D_1$ to $D_5$). Diets 1 & 4 consisted of untreated or treated straw fed alone with mineral and vitamin mixtures. Diet 2, consisted of untreated straw supplemented with sugarbeet molasses providing equal amounts of metabolizable energy as corn and soybean in $D_2$. Urea was added to have N content of $D_3$ similar to that of $D_4$ and $D_5$. Diet 5 was treated straw supplemented with the same amount of molases as $D_3$.

Animals were adapted to diets during two weeks. Digestibility was measured by total fecal collection during 10 consecutive days; both untreated and treated straws were fed at a rate of 30 g DM/$kg^{.75}$. At the end of the digestibility trial, straw offered was progressively increased during 10 days without changing the nature and quantities of supplement. Straw intake was then measured during 10 days; diets were adjusted daily (10% refusable

allowed) and straw was offered 4 times a day (at 0800, 1100, 1400 and 1800 hr).

## RESULTS AND DISCUSSION

In the grazing trial summarized in table 1, one month pregnant Sardi ewes were stocked at 12 or 24 ewes / ha of wheat stubble. Animals under high stocking rate treatment with no supplementation lost 0.6 kg during the first 10 weeks of grazing (table 2). Supplementation with small amounts of alfalfa hay between 5 and 10 weeks of grazing had a positive and significant effect on weight variation ( +3.6 kg). Similar weight gain was achieved by supplemented ewes stocked at low rate. At the start of the 11$^{th}$ week of grazing corresponding to the last five to six weeks of pregnancy, alfalfa supplementation was discontinued and animals in each treatment were randomly divided into 2 subgroups receiving a high (200 g cottonseed meal and 300 g whole barley) or low (200 g cottonseed meal and 50 g whole barley / animal) concentrate supplement (table 1). Concentrate level had no significant effect on ewe liveweight changes during the last four weeks of gestation although low levels tended to give lower weight gains (table 2). Lamb birth weight also was not affected ($P > 0.05$) by level of supplementation during the last month of gestation.

The trial stresses the need for adequate supplementation of pregnant ewes grazing stubble during the last part of gestation. Supplementation is necessary because available biomass tends to be very low after 12 weeks of grazing (1 to 2 T DM/ha). It is also necessary because diet collected by sheep after the first month of grazing stubble has been shown to have low nutritive value, particularly in terms of crude protein (CP) content (Guessous et al., 1987). However, level of supplementation should be modulated also depending on ewe body conditions at the beginning of the 5$^{th}$ month of pregnancy and number of foetus.

In comparison to other data on Moroccan straws (Benata, 1977; McCann, 1985), untreated straw used in this trial had an exceptionally high CP content (6.2 % DM) and relatively low cell wall content (86 % NDF). This can explain why in vivo digestibility of organic matter (DOM) and intake were very high when untreated straw was fed alone without energy or N supplements (51.4 % and 60.7 g/kg$^{.75}$ respectively, table 4).

Similar levels of intake have been reported in Portugal by Dias Da Silva and Sundstol (1986) when chopped straw was fed alone to male sheep; DOM however was 44% only. These results

TABLE 1

Stocking rate and supplementation of pregnant ewes grazing wheat stubble[a], (adapted from Outmani et al., 1988, unpublished).

| Weeks of grazing | Stage of pregnancy (months) | Stocking Rate A 12 ewes ha$^{-1}$ | B 24 ewes ha$^{-1}$ | C 24 ewes ha$^{-1}$ |
|---|---|---|---|---|
| 1-4 | 1-2 | stubble | stubble | stubble |
| 5-10 | 2-4 | stubble | stubble | stubble + alfalfa hay[b] |
| 11-lambing | 4-5 | stubble + concentrate[c] | stubble + concentrate[c] | stubble + concentrate[c] |

[a]. animals in all treatments are supplemented with minerals and vitamins mixture.
[b]. hay supplemented at .5% liveweight
[c]. concentrate provided at high (200 g cottonseed meal and 300 g whole barley) or low level (200 g cottonseed meal and 50 g whole barley / animal / day).

TABLE 2

Effect of stocking rate and level of supplementation during the end of gestation on ewe weight changes and lamb birth weight (kg).

| Item | Stocking Rate A | B | C | SEM[a] | Concentrate (last 4 wks of gestation) Low | High | SEM |
|---|---|---|---|---|---|---|---|
| Ewes liveweight change - first 10 weeks of grazing | 2.9[b] | -0.6[c] | 3.6[b] | 0.39 | --- | --- | --- |
| - last 4 weeks before lambing | 3.4 | 2.8 | 1.7 | 0.5 | 1.9 | 3.4 | 0.4 |
| Male lambs birthweight | 4.1 | 3.9 | 4.5 | 0.14 | --- | --- | --- |

[a]: standard error of the mean.
[b,c] : means within rows followed by different letters are significantly different ($P < 0.05$).

TABLE 3

Diets Composition (dry matter / day)

| Diets | Untreated straw[a] ($g/kg^{-.75}$) | Urea treated straw[a] ($g/kg^{-.75}$) | Soybean meal[b] (g) | Corn[b] (g) | Molasses (g) | Urea[b] (g) | Minerals and vitamins mixture[b] (g) |
|---|---|---|---|---|---|---|---|
| $D_1$ | 30 | | | | | | 20 |
| $D_2$ | 30 | | 41 | 140 | | | 20 |
| $D_3$ | 30 | | | | 162.5 | 15 | 20 |
| $D_4$ | | 30 | | | | | 20 |
| $D_5$ | | 30 | | | 162.5 | | 20 |

[a]. straw allowance is progressively increased at the end of digestibility trial.
[b]. per head

are in contrast with other European data (Chenost and Dulphy, 1987) who suggest that untreated straw DOM and intake usually do not exceed 45% and 40 $g/kg^{-.75}$ respectively. Higher nutritive value of Moroccan straw can be explained by several parameters including varieties cultivated, extent of weed control and method of harvest. Higher levels of intake can also be related to number of meals /d. However, besides nutritional characteristics, these differences may also reflect a better adaptation of some Mediterranean breeds of sheep to high fiber and low quality diets.

Urea treatment increased significantly straw DOM by 7.5 percentage units (table 4). The same variations were noticed for energy and ADF digestibilities. Intake tended to be higher although differences were not significant ($P > 0.05$).

Supplementation of untreated straw with both energy and nitrogen did improve DOM of the whole diet ($D_2$ and $D_3$). However, when corn, soybean and molasses digestibilities were estimated from literature (Demarquilly et al., 1978) and when straw digestibility was calculated by difference, it appeared that supplementation did not affect straw DOM nor ADF digestibility. Straw intake also did not change. These results suggest that urea treatment has been more effective in decreasing ligno-cellulose bonds in the straw than supplying rumen microorganisms with rapidly available sources of energy and nitrogen. The fact that ligno-cellulose (ADF) digestibility is significantly higher for $D_4$ in comparison to $D_3$ corroborates this conclusion.

Comparison between $D_3$ and $D_5$ confirms also the last conclusion. Providing the same amount of urea at feeding time or when treating straw does not lead to the same digestibility of organic matter or ADF. Urea treatment has a better action by affecting cell-wall structure (Chesson, 1986). It may also allow slower $NH_3$ release into the rumen and consequently better synchronization between energy and N fermentations.

On the average, concentrate supplements represented less than 35% of total DM in diets $D_2$, $D_3$ and $D_5$. Supplementation of untreated or treated straw increased the whole ration digestibility. It had no harmful effect on straw digestibility *per se* except in diet $D_2$ which showed the lowest energy digestibility percentage.

TABLE 4

Effects of supplementation and urea treatment on nutritive value of hard wheat straw

| Item | Diets | | | | |
|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ |
| Total ration digestibility, % | | | | | |
| - Organic matter | $51.4^a$ | $62.3^c$ | $63.5^c$ | $58.9^b$ | $67.4^d$ |
| - A. D. F. | $57.3^a$ | $56.7^a$ | $55.3^a$ | $63.9^b$ | $64.3^b$ |
| - Energy | $47.4^a$ | $59.1^c$ | $59.9^c$ | $54.5^b$ | $63.3^d$ |
| Straw digestibility, % | | | | | |
| - Organic matter | $51.4^a$ | $51.7^a$ | $53.6^a$ | $58.9^b$ | $58.7^b$ |
| - A. D. F. | $57.3^a$ | $55.5^a$ | $55.3^a$ | $63.9^b$ | $64.3^b$ |
| - Energy | $47.4^b$ | $43.8^a$ | $49.5^b$ | $54.5^c$ | $54.0^c$ |
| Straw intake | | | | | |
| - g DM / $kg^{-.75}$ | $60.7^a$ | $65.4^{ab}$ | $59.3^a$ | $71.2^b$ | $68.0^{ab}$ |

$^{a,b,c,d}$ : Means within rows followed by different letters are significantly different ($P < 0.05$).

## CONCLUSIONS

Recent trials conducted in the Mediterranean area have shown that ammonia-treated straw can be adequately used by

dry, pregnant and suckling ewes (Cordesse et al., 1988). Diets consisted of 50 to 95 % of total ration DM; supplemented with high quality protein and energy sources, minerals and vitamins. No negative effect was noted in long term trials neither on lamb growth nor on ewe reproductive performance and body weight. Application of such results to urea-treated straw can certainly contribute to improve sheep productivity under the Moroccan conditions.

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# STRATEGIES OF GOAT FEEDING IN INTENSIVE AND EXTENSIVE SYSTEMS OF PRODUCTION

P. MORAND-FEHR

Station of Nutrition and Feeding.
National Agricultural Institute Paris-Grignon (INRA)
16, rue Claude Bernard, 75231 PARIS CEDEX 05, France

## ABSTRACT

Extensive goat rearing systems aim at obtaining often limited production at the lowest possible cost by using well adapted goat breeds that can optimize the environmental forage supplies.

The logical approach of this production system is primarily to best adapt the requirements of the goats during the production cycle to the environmental forage supplies throughout the year. When it is not possible, the goat keepers can use the capacity of storage and mobilization of the energy reserves of available goat breed.

Generally, these production systems can be improved by choosing the best adapted genotype, by a more efficient utilization of rangelands, and by suppling complementary feeds during difficult periods.

The aim of an intensive system is mainly to increase the level of production, in respect to diet, it is characterized by a maximal intake of feedstuffs grown or bought by the farmer. The intensification in production and particularly with regard to diet, can only be economically viable, only if an equal effort is made to improve the animal.

In order to increase meat production per goat, the farmer can make use of five main parameters : fertility, prolificacy, number of births per year, mortality and weight gain of the young. The reproduction rhythm can be accelerated in goats without a season; i.e. the interval between two births can be reduced if the mobilization of reserves at the onset if lactation is not too significant.

The feeding programme for goats of an improved breed for milk production must in general be intensive from the end of gestation until the end of lactation, due to their high food requirements during this period. Shortly after parturition,

the objective is to limit the negative energy imbalance and the mobilization of adipose tissues, which if very intense, can cause metabolic disturbances (cetosis).

In early lactation, as in late pregnancy, high forage quality is of considerable importance. The progressive increase of concentrate supplies and the sufficient quantities of glucose precursors are further conditions for obtaining a good onset of lactation. In a tropical zone, intensive efforts must be made to harvest the forage at a sufficiently early stage in order to preserve its nutritive value.

## INTRODUCTION

The feeding strategies applied to goats must first of all take their nutritional characteristics into account , already described by Devendra (1978), Morand-Fehr (1981) and Louca et al. (1982). Goats are, in fact, characterized by a more pronounced choice of ingested fractions than other ruminants and by a higher digestibility of cell wall carbohydrates with regard to forage with a low nutritive value. These characteristics will be analyzed in more detail during the Symposium on "Constrains and possibilities of ruminant production in the sub-tropics" (Morand-Fehr 1988a).

However, the feeding strategy must also be integrated into the management system applied by the farmer. The remarkable adaptation capacity of goat genotypes enables this species to be reared in both highly intensive and hyper-extensive production systems (Boyazoglu and Morand-Fehr, 1987, Figure 1). Between these two extremes exists a multitude of goat production systems, in which the level of intensification varies according to season.

## FEEDING STRATEGY IN EXTENSIVE PRODUCTION SYSTEMS

### Objectives of feeding strategies in these systems

Extensive goat rearing systems aim at obtaining limited production at the lowest possible cost by using well adapted goat breeds that can optimize the environmental roughage supplies and by distributing only small quantities of cultivated forage or concentrates.

Thus, as already suggested by Johnson and Van Eys (1987), the aim is not to obtain maximum production, but to attain the highest capacity to utilize the vegetation of the rangelands and pastures.

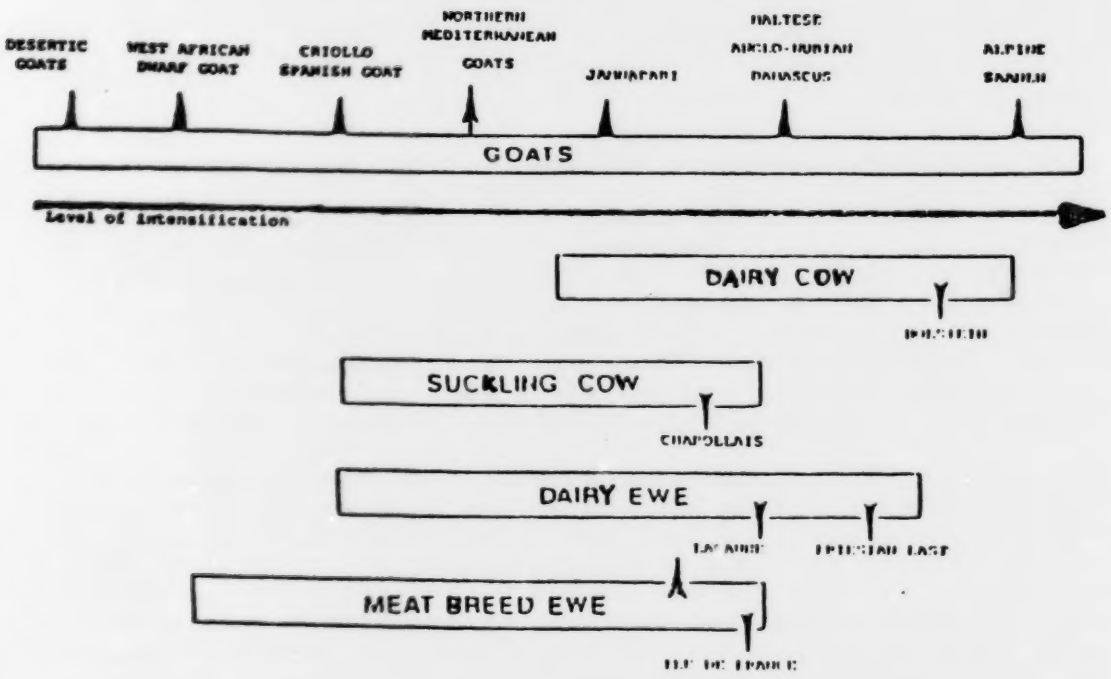



Figure 1. Coincidence of level of Production and Level of intensification .

The logical approach of these production systems is primarily to best adapt the requirements of goats during the production cycle to the environmental roughage supplies throughout the year.

**Utilisation of these strategies**

In the Mediterranean hill regions, the vegetal production of the rangelands is high in spring, with a dry period in summer and a regrowth in autumn. In this case, with a reproduction programme fixing the mating season in October/November and parturition in March/April, the curves representing the goats' requirements and the vegetal production rangelands coincide (Figure 2). In tropical zones, with a vegetal growth in winter, parturition takes place in autumn, thus enabling goats in lactation to benefit it to the full.

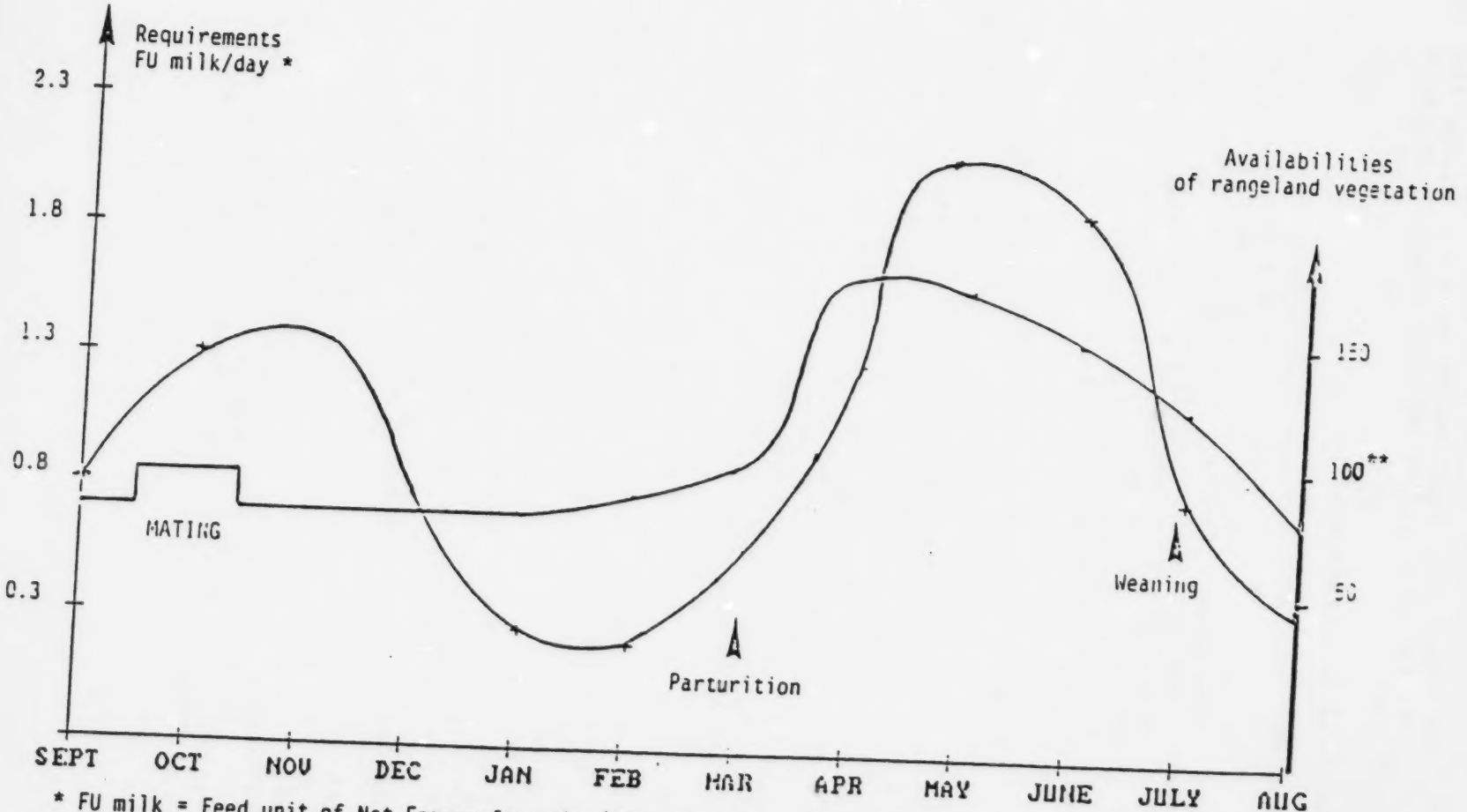
However, in many agro-climatic situations, this is not possible throughout the year. Certain physiological stages with a high requirement coincide with a period of low production or vegetal cessation. Goats are constrained to draw on its energy reserves, i.e. to mobilize the lipids stored in their adipose tissues. In this case, a strategy of overfeeding has to be applied during the period with a high forage supply: and, lipids are stored in the adipose tissues. They can be mobilized in a period of underfeeding. The know-how of the goat farmer in arid areas, enables him to determine to what extent he can use the mobilization and storage of the body reserves, i.e. use the goat "as an accordion", without reducing its production potential. These limits depend on the capacity of the available goat breed.

Over the past years, simple methods based on manual handling were developed from techniques used for ewes (Russel et al., 1969) by Santucci (1984). Now it is possible to determine the variations in goat body condition during the production cycle with similar methods (Morand-Fehr et al., 1988 c). That allows greater precision in a strategy of feeding during various periods of the year, and assist the farmer in the correct choice of management.

**Improvement of feeding management within these systems**

In respect of the animal:

One must choose a type of goats with a maximum level of intake and a high digestive utilisation of the available vegetation, particularly with a poor nutritive value during the unfavorable periods. The goats must thus be good walkers and even climbers in hilly




* FU milk = Feed unit of Net Energy for milk (1FU milk = 1700 Kcal NE milk)
** 100 = Montly average of total annual production of rangeland vegetation

Figure 2. Evolution of feed Availabilities and Requirements of suckling goats.

environments, as good "discriminators" of the most nutritive vegetal fractions. Furthermore, they should show a good urea recycling in the rumen, since the latter partly explains the goat's tendency for a better digestibility of the forage wall fractions (Devendra, 1978 and 1981 and Tisserand et al., 1986). Finally, goats used in these extensive systems must possess a high capacity to mobilise and store the adipose reserves.

All these characteristics present a good adaptation to difficult environments, which is found in certain genotypes (Morand-Fehr, 1988b).

In fact, goats effectively use rangelands with a dominant tree or shrub vegetation (Malechek and Provenza, 1981). In the case of very heterogeneous rangelands(lawn, forest ...), mixed herds of goats with sheep or cattle permit a better utilisation than a herd composed of one species, due to the complementarity between species (Merrill and Taylor 1980; Squires, 1982).

Thus, the choice of animal to obtain a high efficiency in the utilisation of rangelands, does not only concern the goat breed or population, but also the species and even the proportion of the species found in a mixed herd.

In respect of the pastoral environment:

Whatever the type of environment in tropical zone, the rangeland has an unstable balance and is very sensitive to the action of man and animal, particularly in respect of goats; which is the object of the pastoralists' work.

In this paper, only the possible means of improving the utilisation of the pastoral areas by goats are described. The latter cannot be used without taking the evolution of the vegetation into account, especially since the goat can pose specific problems in this regard. Certain suggestions made by Bourbouze and Donnadieu (1987) can be mentioned in this respect.

A better use of rangelands depends on management control. Thus, stocking (number of goats per surface unit), i.e. animal pressure on the vegetation, can be more closely controlled. Soil keeping without grazing, i.e. delayed pasture, can be effective in constituting a reserve in forage for difficult periods. A pasture method which is sufficiently flexible to allow goats to adapt to the variations in annual climatic conditions (continuous grazing or rotational grazing) can be applied more effectively. The control of rangelands in this manner can only be envisaged

within the framework of a sufficiently precise communal organization, closely adhered to, or in the case of ownership of the land by a single proprietor.

However, experience has shown that man, i.e. a highly professional goat-herder or goat keeper, is essential for the good management of rangelands. He is able to estimate the instant value of the rangelands according to the requirements of his herd and thus the rate of stocking to be adopted. In general, stocking must be reduced as the season advance, or otherwise, allow the goats to increase the available biomass by moving them on (Narjisse et al., 1985). He can also choose the maximum altitude according to the season, in order to obtain the highest availability of vegetation for the goats at a particular time. It has also been shown that goats without a goat keeper always use the same paths, thus overgrazing the surrounding area. Within the same zone, the goat keeper should oblige the herd to use less frequented areas that are relatively less grazed.

Furthermore, an attempt is often made to increase the production of grass or vegetation with a relatively high nutritive value, to the detriment of dense vegetation consisting of shrubs and spiky bushes which reduce the pasture area. The control of vegetation, even though quite tricky and often discounted, can be carried out through controlled fires and debuting by mechanical and chemical means. However, due to its marked performance for tree and bush flora (Van Dyne, cited by Malechek and Provenza, 1981)., particularly for spiky bushes, the goat can be used as an efficient and economic tool for debuting or as a firebreak, as well as for cleaning the undergrowth.

**As a complement of rangeland vegetation**

The goat's requirements are met by the rangeland vegetation only, more or less completely according to its nutritive value. Gihad (1976) estimated that the forge intake on rangelands in a dry tropical zone has an energy value of 23 to 43 % of starch equivalents and a value of digestible crude protein of 0 to 16 % DM. Present data show that the vegetation ingested on rangelands in the Mediterranean region also has a very variable nutritive value ; it can be compared with poor quality hays of 600 to 900 Kcal NE/kg DM (Morand-Fehr et al., 1985). However, the energy value of the vegetation ingested can be doubled when stocking is decreased from three to one goat, as observed by Rouaissi and Majdoub (1987) on Tunisian rangelands composed of "maquis" and "garrigue".

In fact, the growth rate of kids or the milk production of

goats reared in an extensive production system are often limited by the value of the rangelands. In an attempt to improve performance, i.e. to intensify the production system, the farmer is obliged to complement the feed intake from the rangelands by other forage, concentrated feeds or harvest by-products, such as straw. This is restricted in duration and quantity; if not, it can rapidly become an intensive system where the rangelands represent only a reduced portion of the ration.

In extensive systems, feed supplements can have two objectives: to maintain minimum body condition during a dry period in order to not disturb reproductive performances, or otherwise, to improve performance during a period of increased requirements, such as at the end of gestation and the beginning of lactation.

In certain cases, the goat cannot be considered as sufficiently optimizing feed complements; in contrast to cattle and sheep. To improve his revenue, the farmer must thus use a goat genotype that is well adapted to the intake of complements.

In all cases, the nutritive value of the ingested feeds from rangelands must be estimated in advance, in order to determine whether energy or protein is the most important limiting factor and whether the intake capacity of the goat enables it to ingest the supplementary roughages.

Feed complements can consist of forage, such as berseem or fodder trees, for example the cultivated , which are used to good advantage by goats (Van Eye et al., 1986, Gihad et al., 1981 and Adiveloo 1986), of cereal straw treated with sodium hydroxide, urea or ammonia (Gihad et al., 1981, Hadjipanayiotou 1984, Vadiveloo 1986, Le Trung and Devendra, 1987), of crop by-products (oilmeals) or industrial by-products (urea) and of cereals.

In order to improve the ingestibility and digestibility of poor quality forage, a complement of starch or protein is generally given to accelerate rumen fermentations. Thus, from certain observations made on rangelands in the Sudan, composed of desert herb "hummira" (Ali and Mustafa, 1984), or on those in the South of France, based on holm oak (Meuret, personal communication), it appears that a nitrogen supply (urea or oilmeals) would improve the utilisation of the rangelands by the goat, in contrast to a starch or soluble carbohydrate supply.

In fact, in systems based essentially on rangelands, feed complements are not a panacea, since they can strongly

minimize the intake from the rangelands, and consequently reduce the advantage of using rangelands by increasing the cost of feed rations. In these systems, feed concentrates should only be systematically envisaged in the case of vegetation shortage, during sensitive periods or during critical physiological stages.

## FEEDING STRATEGIES IN INTENSIVE SYSTEMS

The aim of intensive system is mainly to increase the level of production in respect of diet, this is characterized by a maximal intake of feedstuffs grown or bought by the farmer. The intensification in production and particularly with regard to diet, can only be economically viable, if an equal effort is made to improve the animal. Generally an animal of an improved goat breed for meat or milk production, has a better capacity of efficiently using a high nutritive feed ration.

### Feeding strategy for intensive kid meat production

The production of kid meat makes use of extensive systems and to some extent, intensive systems; the latter are generally less intensive than for milk production, since intensification is only applied at certain sensitive stages of the reproduction cycle: mating, end of gestation and onset of lactation.

In order to increase meat production per goat, the farmer can make use of five main parameters: fertility, prolificacy, number of births per year, mortality and weight gain of the young.

An improved rate of fertility and prolificacy can be obtained by flushing, i.e. by increased feed supplements about one month before the mating season, so that the body condition of goats is sufficiently high at the beginning of mating. In respect of breeds without a sexual season, good body condition must be maintained throughout the year, i.e. above a level that permits to maintain fulfilling reproductive performances. In most cases, energy supplies have proved to be more effective than protein supplies. The level of supplements depends on the nature of the basic ration and the feed deficiency to be overcome, in order to obtain a satisfactory body condition. A supplement of minerals or vitamins given during this period often helps to increase flushing efficiency.

However, flushing is only effective on goats with a poor

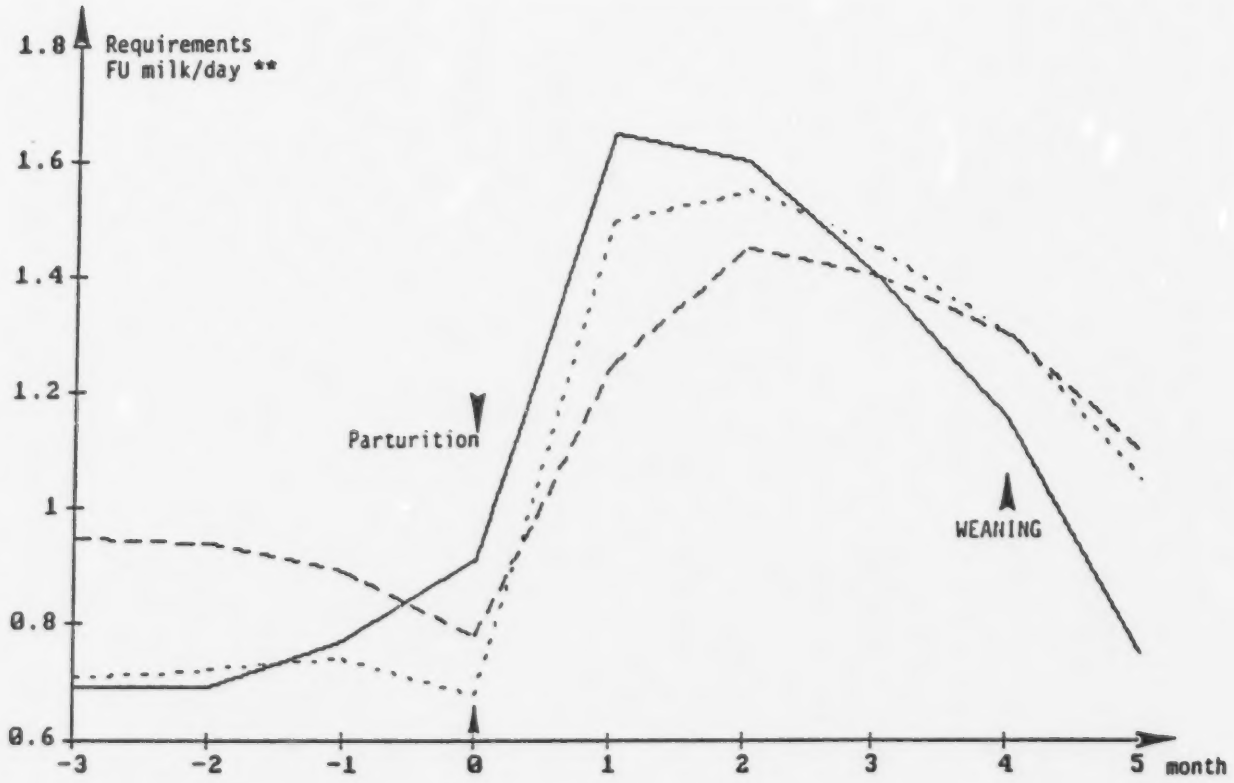
body condition prior to the mating season. It is unnecessary for fat goats. It is even recommended that goats should not be too fat for the mating season, since the oestrus could be less detectable.

The viability of new-born kids, and thus post-natal mortality, is closely linked to feeding management during gestation (Morand-Fehr, 1987). In fact, for the first three months of pregnancy, foetal growth is slow. Slight underfeeding has no severe effect if it is balanced by overfeeding in late pregnancy. Underfeeding in late pregnancy could provoke pregnancy toxemia (Sauvant and Morand-Fehr, 1977), which greatly reduces the viability of kids. During the last two months, energy supplies must be increased by 30% in relation to maintenance requirements. However, before parturition (two to three final weeks of pregnancy), the level of intake in the pregnant goats decreases. Consequently, body reserves must be at their highest before the end of gestation, particularly in the case of large litters.

Other than pathological causes and those linked to an unadapted environment, kid mortality is often due to an insufficient milk production of the dams, particularly in the case of twins or triplets. This milk shortage could be due to a low milk aptitude of the goat or an unadapted feeding programme. In suckling goats, the aim is mainly to produce a high quantity of milk over a short period (six to nine weeks), until the kid is ready for solid foods (concentrates or forage). Two solutions can give the same results; either by heavy feeding of forage with a high nutritive value and of concentrate feeds; or by limiting feed supplements, thus intensively mobilizing the goat's body reserves, on condition that they were sufficiently high at parturition. In other words, the feeding programme during the entire gestation period should allow a high storage level of lipids in the adipose tissues (see Figure 3).

The reproduction rhythm can be accelerated in goats without a season; i.e. the interval between two births can be reduced if the mobilization of reserves at the onset of lactation is not too significant. In this case, it is advisable to feed heavily at the onset of lactation and to wean prematurely, so that the body condition is adequate for the following mating (see Figure 4). A goat giving birth twice yearly must be intensively fed on a continued basis, as in the case of a high milk producer goat, if one wishes to produce three or four kids per year and per goat.

In contrast to milk goats, suckling goats can be fed rations that are relatively poor in roughage and rich in




Curve of requirements

Level of supplies to get a maximal reserve mobilization

Level of supplies to qe a minimal mobilization

* GOATS : kidding twins,weighing 50 kg at mating and producting 2.2 kg at milk at the peak of lactation
** FU milk : feed units of Net Energy for milk production (1 FU milk = 1700 Kcal NE milk)

Figure 3. Various strategies of feeding to meet requirements of suckling goats.

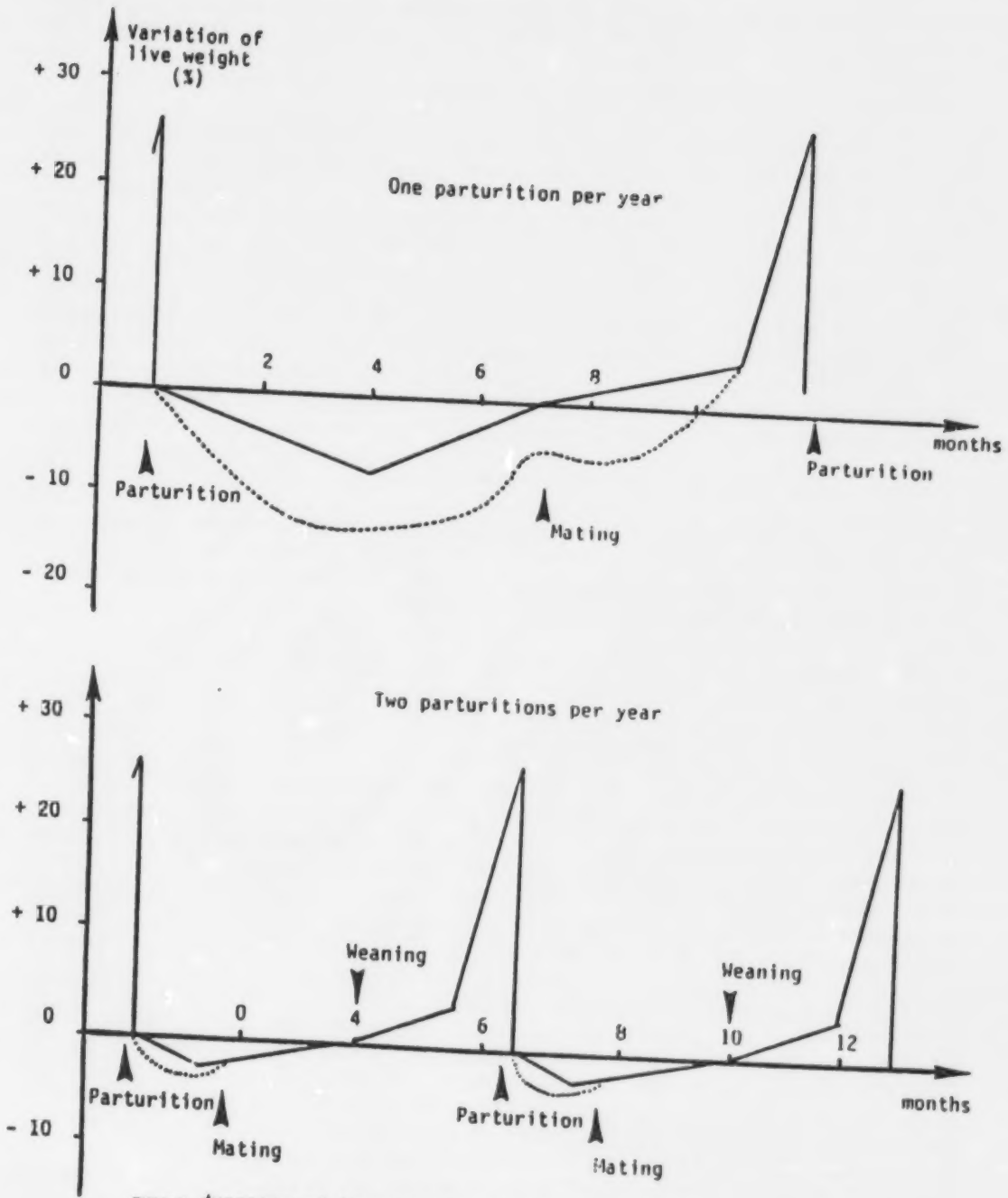



Figure 4. Evolution of body conditions of goats with one or two parturitions per year.

concentrates, or forages of poor quality or straw treated with sodium hydroxide, urea or ammonia, provided the complementary feedstuffs (industrial by-products and cereals) cover the total requirements of the goats.

The growth rate of kids is a linear function of the ingested energy, if the diet is well balanced in proteins and minerals. It can thus be limited by the intake capacity of the kids, or by the energy supply. The feed supplies are increased and are more concentrated in energy, i.e. rich in cereals, in direct relation to the growth capacity of the kids. According to the carcass weight, the required fattening and the date of marketing when prices are most favourable, the farmer can programme the daily weight gain of the kids by partly limiting supplementary roughage and by introducing concentrates at an earlier or later stage.

**Feeding strategy for milk production**

The feeding programme for goats of an improved breed for milk production must in general be very intensive from the end of gestation until the end of lactation, due to their high food requirements during this period.

The feeding strategy in respect of milk goats has already been reported (Sauvant and Morand-Fehr, 1978, Morand-Fehr and Sauvant, 1978, 1980, 1987, Sauvant, 1981 and Skejvdal, 1981). It is similar to the one for suckling goats, but has different objectives: in order to obtain optimal milk performance, it is necessary to maintain a high level of body reserves for the onset of lactation and to avoid an early mobilization of reserves in late gestation. Through numerous experiments carried out in late gestation in early and mid lactation, it was possible to determine a feeding programme for high producer dairy goats: Alpine or Saanen goats, producing 700 to 800 kg of milk per year.

After drying off, the goats' body condition must be determined. If they are too lean after an exhausting lactation period, they must restore their reserves and given forage ad libitum and a high level of concentrates (400 to 500 g a day). On the contrary, if the goats are relatively fat (very frequent in intensive management), it is imperious to limit the level of energy intake by giving forage ad libitum and by limiting concentrates to 0 or 100 g a day. Corn silage forage with a high energy value must be limited; it is better to introduce a forage richer in fibre into the diet.

In late pregnancy, a low energy intake may lead to

pregnancy toxemia and deaths (Sauvant and Morand-Fehr, 1977, Economides and Louca, 1981 and Morand-Fehr et al., 1984).

During the last six weeks before parturition, goats must be given a high quality forage which can maintain a relatively high level of forage intake, in order to minimize the decrease in dry matter intake in late gestation. The concentrate supplies increase regularly from 100 to 200 g daily six weeks before parturition, to 500 to 600 g shortly before parturition. These points are very important, since goats are extremely sensitive to acidosis in late gestation, which is frequent with a poor quality hay and when goat farmers compensate the low level of forage intake by high quantities of cereals. Acidosis is often released in fat goats that received a diet rich in starch, and results in metabolic disturbances (Sauvant and Morand-Fehr, 1977, Morand-Fehr et al., 1984). Moreover, goats that ingested the most energy in early lactation, have the best onset of lactation. Consequently, they have the best capacity of ingestion and the largest volume of rumen, which is closely linked to the level of forage intake in late gestation.

In late gestation, the foetus develops rapidly and there is a considerable need for glucose precursors. It is necessary to introduce starch, thus increasing the production of propionate in the rumen and protein, which contains glucogenic amino acids. Therefore, only a minimum of cereals and oilmeals (or other sources of protein) must be incorporated into the concentrate given in late gestation.

Shortly after parturition, the objective is to limit the negative energy imbalance and the mobilization of adipose tissues, which if very intense, can cause metabolic disturbances (cetosis). It is advisable that the mobilization does not exceed the equivalent of 1.2 kg milk per day. The forage given must be of a high quality; a rapid increase of concentrate intake can provoke digestive troubles, since the rumen microflora does not adapt rapidly to diets rich in concentrates. With a high level of forage intake and a level of concentrates of about 500 g per day at parturition, it is possible to increase this level to 1 to 1.2 kg at third to fourth week in respect of high milk producers (5 to 6 kg milk at third to fourth week of lactation) without digestive or metabolic disturbances. These values must be modified according to the quality of forage.

The requirement of glucose precursors are higher than in late gestation, and 300 to 400 g cereals can easily cover them.

A lack of fermentescible protein has a detrimental effect on milk production. A slight overdose of unfermentescible protein, however, often has a possible effect.

In early lactation, as in late pregnancy, high forage quality is of considerable importance, as shown by Morand-Fehr and Sauvant (1978) and Robstad cited by Skjevdal (1981). The progressive increase of concentrate supplies and the sufficient quantities of glucose precursors are further conditions for obtaining a good onset of lactation.

Following the onset of lactation, the capacity of intake in goats increases and then decreases slowly when production requirements decrease more rapidly. Consequently, when the energy balance becomes positive, amounts of concentrates can slowly be reduced, however making sure that the lipid reserves can be restored. The persistence of milk production during the declining phase of lactation is only favourable if the energy balance is markedly positive. However, care must be taken to ensure that goats are not too fat in late lactation, as the forage intake capacity of goats in late gestation will be too short. Thus , the concentrate quantities given during the declining phase of lactation depend on the quality of forage and the level of milk production; they vary from 150 to 400 g per kg of milk.

However, certain aspects of this programme are difficult to apply in a tropical zone, because of the limited availability of forage and of the often poor nutritive value of the available forage, which is due to the very rapid increase in content of wall carbohydrates with the vegetal growth.

In a tropical zone, intensive efforts must be made to harvest the forage at a sufficiently early stage in order to preserve its nutritive value.

Because of the production of heat linked to the fermentation of the roughage in the rumen, which can have an adverse effect on the goats' capacity to adapt to the heat in tropical zone, higher energy density rations must be given than for temperate zones. The farmer must thus limit poor quality forage supplies, however adhering to a minimum threshold of 40% of roughage in the total dry matter of the ration. He must also incorporate cellulose sources that are easily digestible, such as citrus pulp or beet pulp, soya hulls or brewery grains, particularly when the content of long fibre in the ration is low, and supply concentrates rich in cereals, oilmeals, and eventually limited quantities of fat (40 to 80 g per day and per goat).

In irrigated areas, the supply of green forage low in dry matter can limit the level of ingestion in goats. It is thus necessary to incorporate dry forage into the ration.

## CONCLUSIONS

Feeding strategies in goat rearing must thus be based on the aims of production (optimal performance of goats, maximum utilisation of rangelands, reduction of labour, etc.), forage availability and, above all, on use the aptitudes of the genotype used, particularly its suitability to use the vegetation of the rangelands and to mobilise and store its body reserves.

In all the cases, we have to keep in mind that one feeding strategy exists to achieve the aims of production, but generally environmental or economical constrains make obligatory to choose the best suitable solution.

Over the past few years, considerable progress has been made in the understanding of goat nutrition. Rational feeding methods and feeding programmes adapted to this species were thus put at the disposal of farmers. However, taking into account the heterogeneous characteristics of goats, an inventory of the characteristics of each genotype should be made, so that the feeding strategies are even better adapted to the goats in question.

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# FEEDSTUFFS SUPPLEMENTATION IN DETERIORATIVE RANGELANDS : EFFECT ON PERFORMANCE OF SMALL RUMINANTS IN ARID AND SEMI-ARID REGIONS.

A. M. EL-SERAFY[1] and A. S. EL-SHOBOKSHY[2]

1. Department of Animal Production, Faculty of Agriculture, Ain Shams University, Shoubra Al-Kheima, Cairo, Egypt.
2. Department of Animal Production, Faculty of Agriculture, Zagazig University, Egypt.

## ABSTRACT

Rangelands of arid and semi-arid regions are deteriorating in productivity because of reasons other than natural drought. Increasing livestock number, improper range management and unawareness of range-users about the benefits of long-term range improvement plans, are main reasons for loosing range productivity.

The nutritive value of utilizable fodders in deteriorative rangelands decrease as a result of water-lack, extremely high temperature and continuous grazing and defoliation. Consequently, crude protein decrease and non-protein-nitrogen and crude fiber increase.

Feedstuffs are used as supplements to the range in drought seasons, but the need is greater, for these supplements in physiological stressing factors; late pregnancy and lactation. Energy is the main nutrient needed in these supplements although ammonia-treated roughages are sometimes used.

Generally, a significant improve in performance of small ruminants occur as a result of feeding low or medium-energy level of supplement since dependance on grazing alone in deteriorative rangelands, can hardly satisfy the maintenance requirement of ewes and does. The improve in reproductive performance of ewes may increase by two-folds as a result of supplementation.

Applying common research findings to NW rangelands of Egypt, suggests to introduce supplementary feeds in times of physiological stress rather than in drought per se, even if the range situation is relatively in a better condition.

The practice of feedstuff supplementation if becomes a

habit to range users, may lead to a serious socio-economic problems.

## INTRODUCTION

Rangelands are considered natural resources of arid and semi-arid regions. Their trees, shrubs, semi-shrubs and herbage not only provide feeds and shelter for grazing / browsing livestock, but they also have other useful uses as nutrient recycling and soil fertility; industrial and medicinal; ornamental and food for humans (Zaroug, 1985; Maldanado, Le Houérou, 1980).

Significant areas of rangeland regions are witnessing however, serious deterioration of its vegetation cover because of factors which include human errors and natural drought.

The aim of this communication was to review available research on productive performance of small ruminants (SR) grazing / browsing in deteriorative rangelands in arid and semi-arid regions. This review was intended to specify : reasons for rangelands damage, reasons for the need of feedstuff supplements and to integrate specific research findings on SR to the sheep production system in the NW rangelands of Egypt.

## REVIEW

### 1. Ecological features pertinent to range pasture production and management

Arid and semi-arid areas are characterized by an annual rainy season which usually precipiates from 70 to less than 200 mm of rain. This volume of moisture meets the needs for growth of natural range plant species beside the growth of barley which is by experience, in some semi-arid areas, usually seeded just before the rain starts (e.g. NW rangeland of Egypt).

From the range plants production standpoint, there is an over-adequate supply of feed-nutrients for grazing and browsing ruminants during the rainy season. It is an acceptable fact now that, this supply may last for a month or more following the cessation of the rains but is then followed by a shortage or severe shortage of quality feeds during the rest of the year. From the literature, it is evident that on all-year-round basis, natural range pastures under such conditions can satisfy at least the maintenance requirements of small ruminants if their production system is extensive in nature with a stocking rate of about animal

unit per 3 ha (7 feddans) of range-land.

The above described situation is not always the common case in most arid and semi-arid areas because of one or both the coming reasons (Le Houerou, 1988; 1980; Draz, 1980):

First, the wide fluctuation which occur in precipitation within a season and among seasons particularly in the duration of the rainy season and the occurrence of what is termed by the "drought cycle".

Second, the poor management practices exercised by the range-users which results in increasing ruminants number and an over-grazed range-land situation.

Relatively, the poor management practices have greater constraints on range productivity since the users of the range in most areas, have not developed systems for controlled grazing, production of grazing rights and range reserves (Draz, 1983). In the literature, examples are found for describing the effect of poor management on natural range productivity. Draz (1983), reported that range deterioration, degradation of plant cover and low productivity are now common features of the arid and semi-arid range lands in many countries of the Near East. In Egypt, preliminary survey studies carried out by the MOA (Aboul-Naga et al., 1987) indicated a serious deterioration of the NW coastal range-lands. In that survey, the main reason for such deterioration was the improper range management practices.

Too many poorly managed animals over-graze the range pastures causing deterioration of vegetation, and closely defoliation; this practice cause reduced vigor, lessens seed production and eventually, plant death (Heady, 1975). Moreover, the observed desertification in semi-arid regions is due to overgrazing/browsing and the removal of firewoods which lead to exposing of the soil to water and wind erosion (Roberts, 1987). The introduction of improved pasture species to deteriorative rangelands could be a solution for increasing its pasture cover. This technique may increase carrying capacity by ten folds (Edye and Gillarad, 1985) but needs the addition of fertilizers. Unfortunately, the cost of such inputs in semi arid regions are so heavy to limit the use of this technique.

## 2. Effect of drought on nutritive value of range plants and their palatability

The literature was reviewed with regard the effect on the nutritive value of range plants of natural drought or

water-lack. There is a general agreement on the fact that the nutritive value of range plants whether annuals or perennials, decrease as a result of water shortage (Rae et al., 1963; Hassan et al., 1980 a). This decrease in nutritive value is due in great part, to a decrease in crude protein content joined with an increase in the fiber component (Vera, 1973); Hassan et al., 1980b; Benjamine et al., 1986; Van Soest, 1982). The increase in NPN as a result of water shortage (Wilson, 1966; 1977) could explain more the reduction in digestibility. Shrubs like Atriplex Spp. grown under the stress of water-lack, although contain as high as 20% crude protein (Wilson, 1977), yet more than 60% of that protein is in the form of NPN which result in lowering organic matter digestibility to as low as 40-45 % (Benjamin et al., 1986). Water stress and extremely high temperature are contributing factors to the low protein content of herbage at different stages of growth (Lyttleton, 1973).

The relationship between nutritive value and seasonal growth of range pasture can be best described in graph. 1 which summarize data reported by Abdel Aziz (1982) Hassan et al., (1980b) for a mixture of annuals and perennials growing in the NW arid zone of Egypt or in Southern Sinai.

Since the chemical make-up of the plant is directly related to its palatability (Malecheck and Provenza, 1983; GRM, 1982) and in particular to the presence of what is termed secondary plant metabolites, that range-plants become less palatable in drought situation, at least for a grazing ruminant like the sheep. The goat on the other hand, with its highly selective sense under different feeding / management systems in different climatic environmental conditions, (Devendra, 1981; Gall, 1981; Merrill and Taylor, 1981; Morand-Fehr, 1981) can easily modify its nutritional and physiological state to overcome the newly developed stress condition. The following data (GRM, 1982) show the relative palatability by sheep and goats of three arid-range-fodders and its relationship with chemical composition:

| Fodder plant | Relative Palatability | | Chemical analysis % DM | | | |
|---|---|---|---|---|---|---|
| | Goats | Sheep | N | P | K | ash |
| Acacia ehrenbergiana | ++ | + | 2.3 | .17 | .61 | 7.8 |
| Acacia tortilis | ++ | + | 2.8 | .14 | .51 | 8.4 |
| Atriplex nummularia | + | + | 3.1 | .13 | .67 | 13.8 |

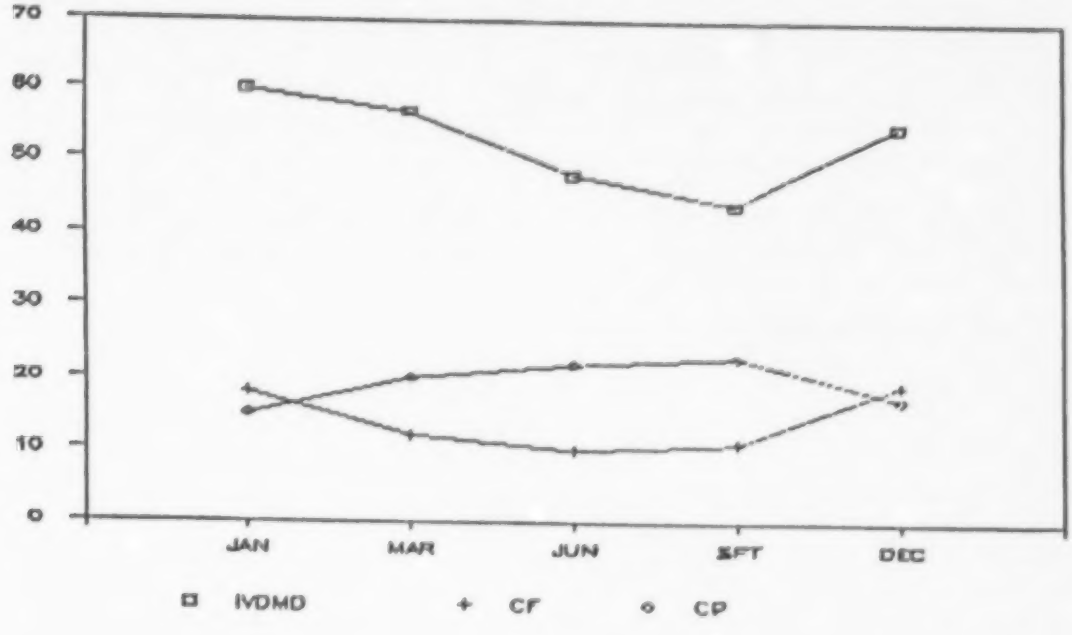


Figure 1. Effect of season on the nutritive value of range-fodders of semi-arid regions in Egypt.

Some herbaceous species which grow after rain in arid and semi arid regions are usually more palatable than other shrubs or semi-shrubs. Seligman et al., (1986) and Benjamine et al., (1986) reported palatability ranking of five fodders by sheep as: crucifera > Cassia sturtii > Atriplex; (A) canescens > A. nummularia > A. linearis > Acasia victoria.

### 3. Supplementary feedstuffs and its effect on ruminants grazing in arid and semi-arid areas; Why, How, When and How much

From the discussion presented above, it can be extracted that one important reason for the need of supplementary feedstuffs to range pasture, is in drought situations. Another more important reason for that need, arises when the animal is under internal physiological stress condition; late pregnancy and early lactation (El-Serafy, 1988). From a biological point of view, the need for more quality feed-nutrients is greater under the physiological stress than under climatic stress, since experimental evidences of adaptive mechanisms to combat heat and water deprivation has been reported (Farid, 1987). These adaptive mechanisms are: heat tolerance, fluctuation in body temperature, decreasing feed intake and long-term adaptation to protein deficiency.

When small ruminants are grazing on Atriplex nummularia as sole feed, they do not satisfy their production requirements of energy; sheep may not obtain even their maintenance energy requirements. The data of table 1 (Shehata et al., 1987) indicate an average loss and gain per weights of sheep and goats, respectively of 19.4 & 11.9 g.

Based on the energy requirements values for sheep (NRC, 1978) and goats (Devendra, 1967; Lindahl, 1968), the author calculated the annual TDN requirement by ewes and does at different weight categories and at different physiological status (table 2). The data indicate that the requirements at late pregnancy and lactation for ewes and does bearing only singles is about 2.4-2.5 times the maintenance energy need in maximum activity; such high requirements can not be met by grazing natural range plants alone since in this case the animals will desipate more energy in searching for food (GRM, 1982).

Supplementary feedstuffs are purchased in different forms depending on different factors as availability, price and location of the range. Main feedstuffs forms however, are either pellets or blocks for concentrate mixtures or bales for hay & straw.

TABLE 1

SR Performance trials :
I. Effect of grazing on productive performance*.

| Item | Sheep | | Goats | |
|---|---|---|---|---|
| | Rams | Ewes | Bucks | Does |
| No. of animals | 4 | 39 | 4 | 39 |
| Body weight, kg | 43.9 | 30.8 | 25.9 | 21.6 |
| Avg. MBS ($w^{.75}$, kg;A) | 17.1 | 13.1 | 11.5 | 10.0 |
| ADG OR Loss, g | -27.2 | -13.8 | -15.3 | -12.9 |
| " " % BW | .62 | .115 | .59 | .60 |
| DMI, g /A | 28.9 | 55.7 | 38.9 | 71.5 |
| % in vivo Digestibility | 40.9 | | 45.0 | |
| DDMI. g / A | 11.81 | 22.8 | 17.51 | 32.2 |
| Water consumption: ml | 3200 | --- | 1486 | --- |
| % BW | .73 | --- | .57 | --- |
| ml/A | 188 | --- | 129 | --- |
| ml/gDMI | 6.5 | --- | 3.33 | --- |
| ml/gDDMI | 15.1 | --- | 7.38 | --- |
| No. of females, lambed | | 12 | | 16 |
| Lambing % | | 30.7 | | 41.0 |
| No. of lambs born alive | | 15 | | 25 |
| Lambs / lambing | | 1.25 | | 1.56 |
| No. of lambs weaned | | 12 | | 19 |
| % mortality : birth-weaning | | 20 | | 24 |

In Egypt, the MOA (ARC, APRI) is recommending ammonia-treated rice straw as a summer feed supplements for feeding pregnant ewes and growing yearlings of the coastal NW range lands. Training of the bedouins on the ammoniation process is planned through the CALAR project (Aboul-Naga et al., 1987). The chemical analysis (in % DM) of that feedstuff supplement was as follows (Shehata et al., 1987) DM: 89, DM, CP, 9.5; CF, 35; Ash, 14: NFE, 395. The calculated nutritive value (by the author) was : TDN, 35 and DP, 5 %. A ton of the ammonia-treated straw costs between LE, 55 to 65 depending on location of the range.

In Sultanate of Oman, the MOA offered a mixed grass legume-hay (50% TDN and 6% DP) to livestock holders in the drought seasons from 1981 through 1985 (El-Serafy, 1988). In the severe drought season of 1984 however, a concentrate

II. Effect on productive performance of sheep and goats, of controlled grazing on Atriplex nummularia in NW arid region Egypt.

| Item | Sheep | Goats |
|---|---|---|
| No. of animals ( ) | 7 | 8 |
| Avg. Initial BW, kg | 52.1 | 39.3 |
| " Final BW, kg | 51.4 | 39.7 |
| Mean MBS ($kg^{.75}$), kg | 19.4 | 15.7 |
| ADG / Loss, g | -(19.4) | 11.1 |
| DMI : | | |
| g/ d | 1434 | 1210 |
| g/ $w^{.75}$ | 73.9 | 77.1 |
| Water consumption: | | |
| ml/ d | 3.94 | 2.55 |
| ml/ $kg^{.75}$ | 204 | 163 |
| ml/ g DMI | 2.75 | 2.11 |

III. Effect of supplements on productive performance

continued

| Treatment | | ADG g/d | No.of Ewe lambs | No.of Ewes lam. | Lamb. % | No. of lambs | Lambs/ lambing |
|---|---|---|---|---|---|---|---|
| S* | 1. Shrubs & barley grain | 90 | 24 | 6 | 25 | 8 | 1.33 |
| | 2. Wheat after maths&18% concentrate | 120 | 26 | 10 | 38 | 14 | 1.40 |
| | 3. Pen-fed barrley grain, poultry lit. & straw | 124 | 23 | 8 | 35 | 13 | 1.63 |
| L* | 4. Shrubs & wheat straw | 000 | 25 | 11 | 44 | 16 | 1.45 |
| | 5. Barley after maths & | 41 | 25 | 15 | 60 | 23 | 1.53 |
| | 6. Wheat after maths with legume residues & 12% concentrate mix. | 91 | 69 | 32 | 46 | 38 | 1.19 |

* S & L = Small & Large sheep.
- All small sheep (T 1,2,3) grow to the aimed weight; 40 kg.
- Sheep grazing on shrubs were 3.5 kg less than the other treatment / group.
- All sheep suffered from a skin disease for 15 days before recovery.

TABLE 2

Energy and protein requirements of ewes and does during different levels of activity and physiological status*

| Activity / stress | | Requirement, g/a/d/w$^{.75}$ | | | |
|---|---|---|---|---|---|
| | | TDN | | DP | |
| | | ewe | doe | ewe | doe |
| Maint-enance | $M_1$ | 29.3 | 29.5 | 2.61 | 2.61 |
| | $M_2$ | 32.2 | 36.9 | 2.87 | 3.20 |
| | $M_3$ | 33.7 | 39.0 | 2.98 | 3.43 |
| Production | $P_1$ | 35.2 | 35.9 | 2.87 | 3.25 |
| | $P_2$ | 52.4 | 53.1 | 4.70 | 4.70 |
| $P_3$ | | 72.6 | 73.2 | 6.9 | 6.90 |

pelleted feed mixture (45% TDN and 7% DP) was sold in subsidized price, to livestock holders in addition to the hay. Some livestock holders in that year fed sheep and goats on dried sardines and dried palm-dates; a feeding practice common only for lactating cows.

The amount of feedstuff-supplement to grazing / browsing ruminants, has a determinatal effect on their productive and reproductive performance and on the amount of range-plants consumed. Supplemental barley to grazing sheep and goats in experiments conducted in Southern Sinai (El-Shaer et al., 1982) have shown that the high level of supplement given to late pregnant-early lactating ewes and does, resulted in improving ($P<0.05$) birth weights and weaning weights of lambs and kids as compared to either the medium or low levels of supplement. From birth to weaning, average daily gains (ADG; g/d) of lambs born from ewes fed on the high, medium and low barley supplements were 270, 200 and 70 g/d, respectively) were 130, 112 and 72, respectively. Corresponding values for goats were: 50, 160, 210 g barley / animal /d and 56,62 and 63 g ADG. Milk production of both ewes and does was improved ($P < 0.05$) by increasing level of supplemental barley.

Dry matter intake from grazeable pasture native to Southern Sinai area (El-Shaer et al., 1982) and of Atriplex spp. (Shehata et al., 1987; Benjamine et al., 1986) increased when barley grains was given as a supplement to sheep or goats during late pregnancy and lactation. In these studies, DM and OM digestibility of the grazeable plants increased as a result of concentrate supplementation.

On-Field grazing trials conducted by Steele and Dutton, (1983 at Al Khaboura Station, Sultanate of Oman), showed that, a mature crossbred ewe of 40 kg average body weight, required 60-70 kg of pelleted concentrate mixture (60% TDN; 11% DP) during a period of 90 days of physiological stress (last 6 weeks of pregnancy and first 6 weeks of lactation).

Reproductive efficiency (as judged by lambing percent) of ewes and does grazing natural range pasture alone, did not exceed 45% (Benjamine et al., 1986). When a feed supplement of a high energy content was given in addition to grazing, lambing percent increased by 15 percentage units. Lambs per lambing was 1.33 and 1.53 for ewes grazing Atriplex spp. only and for those on Atriplex plus barley, respectively.

From previous data in the literature, regarding the effect of grazing alone or with added levels of barley grains as supplements, the author illustrated these data (figure 2) to describe its effect on either gain on weight in males or on lambing percent in ewes. Examination of this graph indicate that the magnitude of the effect of level of supplement on lambing percent in ewes is greater than on the gain in weight of mature males.

There is a relationship between feedstuffs supplementation, water consumption and moisture content of grazeable pasture. Water consumption by small ruminants especially sheep, increases with increasing dry matter from concentrated feedstuffs and is usually correlated with dry matter intake (Blaxter and Wilson 1963; Shkolnik et al., 1975; 1980). In goats, total water intake was linearly related to energy intake and grazing-lactating goats consumed twice as much water as grazing, non-lactating ones (Shkolnik et al., 1980; Wittenberg et al., 1986; Maltz et al., 1982). On the other hand, the relatively high moisture content of grazeable pasture in the wet season, decrease water intake by 60% in rams and by 25% in goats (El-Shaer et al., 1982; Benjamine et al., 1975). To support this finding, it has been reported (El-Serafy 1988) that a group of crossed rams (½ Awassi . ½ Omani) grazing Rhodes grass (73% moisture) consumed 50% less water than another group grazing indigenous perennials (42-48% moisture).

## Integration of feedstuff supplementation with sheep production system in the NW arid area of Egypt

An illustration was made by the author (figure 2), in order to describe the productive flow-scheme for small ruminant production system in the NW region of Egypt and its relationship with range nutritive value and feedstuffs

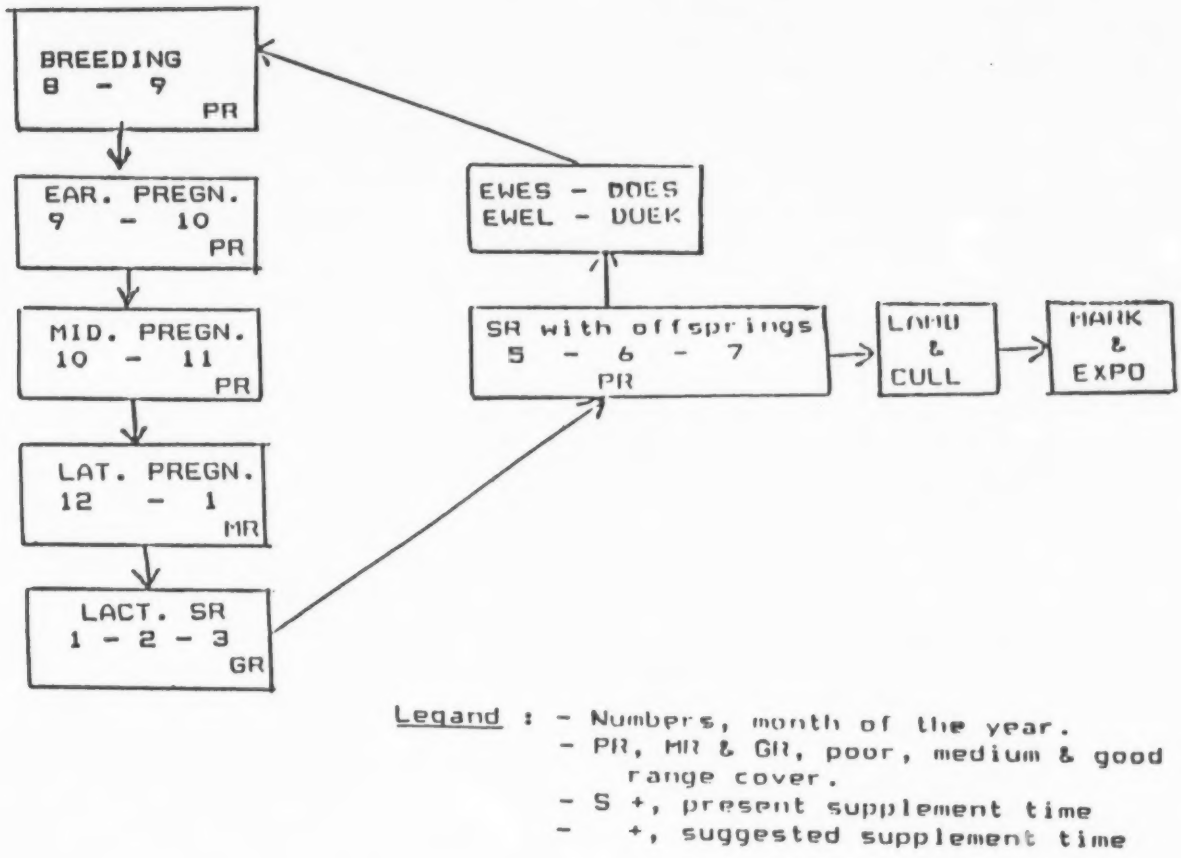


Figure: 2. Productive flow scheme for SR Production system in NW rangelands of Egypt: a suggested time for feedstuff supplement to the range.

supplementation. From this figure, it has been suggested that feed supplements to sheep grazing in this area, should be limited to times of late pregnancy and early lactation (December through March) although the situation of the range is relatively good. A small fraction of this supplementary feeds might be given in breeding time (August through September) where the range is described as relatively poor. This procedure is suggested to replace the common practice by range-users of giving feed supplements during the drought season (May through August).

**Problems encountered with feedstuffs supplementation in range-pasture areas**

From the above discussion it can be summarized that feedstuffs supplementation to ruminants grazing / browsing indigenous plants of arid and semi-arid zones, is sometimes necessary for maintaining a threshold performance of at least ewes. The onset of supplementation however, is of importance; feeds should be given in times of physiological stress than be given in drought season per se. Many socio-economic problems may arise however, from feedstuffs supplementation programmes. One of these serious problems is that range users may neglect or at least act reluctantly to developmental programmes aimed at range development: residing, improvement and reservation. In some cases, supplementary feedstuffs become a social habit which by time, is hard to abundant. Moreover, supplementary feedstuffs necessitate drilling of more water holes in some areas or at least increasing frequency of watering animals in others. In this situation, an increase in small ruminant numbers is unavoidable with the consequence of over-grazing and more deterioration in range productivity is expected. Added to that, more and more feedstuffs supplement will be needed; a viscous cycle which usually ends up with complete desertification of the range area.

In general, feedstuffs supplement programmes unless carefully designed and practiced, might lead to a serious damage to range productivity.

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# USE OF SYRIAN MARGINAL LAND FOR FAT-TAILED SHEEP PRODUCTION

F. BAHHADY, A. OSMAN and L. RUSSI

International Center for Agricultural Research in the Dry Areas
(ICARDA), Box 5466, Aleppo, Syria

## ABSTRACT

Marginal land in Syria is mainly used for grazing, and in many places been misused by cultivation and overgrazing. It occupies 30% of the cereal zone of western Syria. Improvement is difficult as the land is steep and soil is shallow. Productivity can be increased by changing management, sowing pasture species and supplying adequate soil nutrients, mainly phosphorus. Supplementary feeding of sheep and goats began in early 1950's. Combined continuous light grazing under limited stocking and phosphorus application can significantly increase pasture availability and quality, and animal productivity.

This paper describes an experiment in which there were three rates of phosphate (0, 25 and 60 kg per ha of $P_2O_5$) and two stocking rates (0.8 and 1.7 sheep per ha) in a factorial design with three replicates in an area of marginal land. Plot sizes are 3.0 ha for high stocking rate (SR) and 6.5 ha for low stocking rate. The total area was 83 ha. Flock size was equal for all plots (five Awassi ewes).

Soil samples for total and available phosphorus were taken every year and measurement of herbage each month throughout the growing season. Seed yield was measured in June. Sheep and their lambs were weighed each week, milk and wool production were recorded.

More than 87% of soil samples so far analyzed were poor in phosphorus (less than 10 ppm). This value increased to 10-15 ppm after applying fertilizer. The effect of fertilizer on grasses and herbs was slight in year 1 and 2 but was evident in year 3, when grasses and herbs of treatments $P_{25}$ and $P_{60}$ contributed about 400 and 500 kg per ha, respectively to total biomass. Legumes responded in year 1 and 2 and the effect was the largest in year 3 where the treatments $P_0$, $P_{25}$ and $P_{60}$ contribution were 140, 500 and 460 kg per ha respectively. Seed yield of legumes was high, and in year 3 treatments ($P_0$, $P_{25}$ and $P_{60}$ gave 21, 68 and 99 kg per ha of seed, respectively.

Sheep grazing fertilized pasture were heavier than the controls. Sheep at the low SR were significantly heavier than at high SR in all years. Lambs at low SR were heavier but there were no differences according to rates of fertilizer. There was no effect on milk yield either by phosphorus or stocking rate. Sheep grazing at $P_0$ received more supplementary feed than those grazing $P_{25}$ and $P_{50}$ (845, 424 and 525 MJ per ewe). Sheep grazing at high SR received more extra feed than at low SR in year 3 (907 and 380 MJ per ewe), and duration of supplement at high SR was longer than at low SR (108 versus 41 days).

## INTRODUCTION

Marginal land within the cereal zone in Syria is mainly used for grazing by livestock. Marginal land is the land receiving more than 200 mm of rain which is too dry, too steep, or in which the soil is too shallow for cultivation (ICARDA Annual Report, 1985). This land occupies large areas in Syria and other countries of the Middle East and North Africa. It is mainly common land owned by the state thus the grazing is communal. Many areas of marginal land were misused either by overgrazing or later by cultivation which was expanded in the early 1950's after the introduction of tractors and machinery. This was followed by supplementing livestock at various times of the year by feeding barley, legume grains and straws in winter and grazing stubbles in summer. At present, these areas constitute about 30% of the total land surface in the cereal zone of western Syria. Marginal land is important to the livestock owners as it represents the only land available for grazing between October and May, and has importance to the economy both to the villages and to the country as a whole.

Improvement of marginal land is difficult, as it may be steep, and soils are shallow and stony. The land is intensively grazed and soil erosion is severe in some years. Improving marginal land productivity could reduce feed supplement of grazing livestock and increase farmers income.

Results of the ecology of marginal land study in North West part of Syria indicate that there may be three methods of increasing productivity. The first is to change grazing management, the second is to change botanical composition by sowing improved pasture species, and the third method is to apply superphosphate.

Grazing management might be the only method applicable for increasing marginal land productivity in dry areas. By

reducing grazing pressure during the critical period of seed set and continuous grazing where stocking rate is limited by available pasture in winter, improvement of pasture could be achieved. In Southern Australia feed supplement to maintain flocks varied from year to year, but was more under differed grazing than under continuous grazing (Brown, 1976) and there were no differences in animal production.

The second method of improving marginal land productivity is by sowing improved pasture species to change botanical composition. This approach is applicable when the existing botanical composition of the pasture is inadequate, especially in legume. ICARDA's work in some parts of Syria indicated that adequate legume populations are already present (200 legume plants per $m^2$ at Bueda). In addition to that, pasture establishment is possible. Seed can be obtained cheaply and suitable genotypes are available.

The third method is to apply superphosphate. Soils of Syria are low in phosphorus and application of superphosphate should increase livestock production, although this depends on several factors other than soil phosphorus. An adequate number of plant must be present, floristic composition of grasses and legumes should be suitable, and pasture utilizations efficient. Beside that, prices of fertilizer and animal products are favourable.

The use of superphosphate on permanent pasture is common in Australia; 40 million ha of grazing land are top-dressed annually ( Williams and Andrew, 1970). Response of pastures to superphosphate application in Australia depends on an introduction of pasture legumes as Australia has no native herbaceous legumes (Donald, 1970). Response in herbage production has been obtained (Anderson 1946; Carter, 1958), and it is estimated that livestock production has been increased at least four - fold (Russell, 1960) since superphosphate was first applied.

At Tel Hadya (ICARDA's Research Station in Syria) a combination of applying superphosphate and improved management might be the best approach for improving marginal land productivity. Continuous grazing has been selected as the management technique.

## MATERIALS AND METHODS

The experiment was a 2x3x3 factorial design; two stocking rates, three rates of phosphorus application, and three replicate. The treatments were arranged in a randomized complete blocks.

The three rates of phosphate were : 0, 25 and 60 kg per ha of $P_2O_5$ (or $P_0$, $P_{25}$ and $P_{60}$). Stocking rate was flexible depends on pasture available during winter. Presence of 500 kg per ha of pasture in January in the high stocking rate of 60 kg ha was adequate to provide the energy and protein requirement of grazing sheep (Smith et al., 1972,1973).

Initial stocking rates were 0.8 sheep per ha (low SR) and 1.7 sheep (high SR). Plot sizes were 3.0 ha for high SR and 6.5 ha for low SR. The total area was 83 ha. The pasture of this area was dominated by annual grasses, Bromus and Avena and more than 40 legume species were present mainly Trifolium campestre, T. tomentosum and T. stellatum, most of them being common on marginal land in Syria. Flock size was equal for all plots and comprise five Awassi ewes and their lambs and this number can be increased from five to six or even seven. Stocking rate was based on a modified form that of Owen and Ridgman (1968). Their system assumes that at low stocking rate, improvement will not appear. When stocking rate increases, the effect on poor pasture will become clear. They use short term changes in stocking rates based on available pasture. In this experiment the stocking rate was based on available pasture in January.

Ewes were mated in August and September each year and lambing begins in January and February. When ewe size falls below 40 kg, they are fed to maintain satisfactory condition, especially at mating because some reduction in fertility could otherwise be expected (Thomson et al 1983).

Soil sampling started in November each year before fertilizer application. Total and available phosphorus, total nitrogen and organic matter were measured.

Measurements of herbage each month throughout the growing season was taking place inside and outside cages and separated into grass, clover and herbs components, then weighed, bulked and analyzed for total phosphorus and crude protein. Seed yield was measured in June and weighed according to species.

Sheep were weighed each week to record their live mass change and plan for feeding if size falls bellow 40 kg.

This experiment started in 1984/85 and sheep were introduced in 1985/86, this gave an opportunity to gain some idea of herbage productivity and to establish differences in pasture availability.

## RESULTS AND DISCUSSION

In the first year of the experiment fertilizer (triple superphosphate) was applied in November 1984 following soil sampling. Herbage was sampled monthly on six intervals beginning from December to May along a transact. Plants were separated into legumes, grasses and other species, dried and weighed. Seed yield was measured in June.

Analytical results of the soil samples indicated that more than 87% of the samples were poor in phosphorus and had values less than 10 ppm.

In the second year, the level of phosphorus in the control treatment did not change and was less than 10 ppm of P, but on the medium and high treatments the values were more than 10 and 15 ppm, respectively.

The effect of phosphate application on available biomass of grasses and herbs (average of two stocking rates) was slight in year 1 and 2 and conspicuous in year 3 as shown in Table 1. Treatment $P_{25}$ gave the highest biomass of grasses but no differences were shown in the last two weeks of sampling. For herbs $P_{60}$ gave the highest biomass, but no differences were shown at the end of the growing season. Grasses and herbs contributed about 400 and 500 kg per ha, respectively, to total available biomass.

Legume response to phosphate fertilizer started in year 1 and 2 and was the largest in the year 3 (Fig. 1). Their contribution was greater at $P_{60}$ (640 kg per ha) than at $P_{25}$ (500 kg per ha) and $P_0$ (140 kg per ha). The total available biomass reached 1580, 1440 and 1050 kg per ha ($p<0.05$) at the final harvest, respectively.

For legumes, seed yield and seed number increased with phosphate application and with time as shown in Table 2. This resulted in the development of a better plant density and a higher mass per plant.

In general, applying phosphate will benefit pasture availability both during and at the end of the growing season, mainly due to the increased contribution of legumes. Apart from the higher yield of dry matter, there will also be improved forage quality and protein content.

The effect of stocking rate on pasture productivity is shown in Table 3. Grazing reduces plant density, in year 1 plant density in February was over 8.500 plants per $m^2$, in year 2 after sheep being introduced plant density was 3370 rising to 5680 in year 3,in year 2, when grazing commenced,

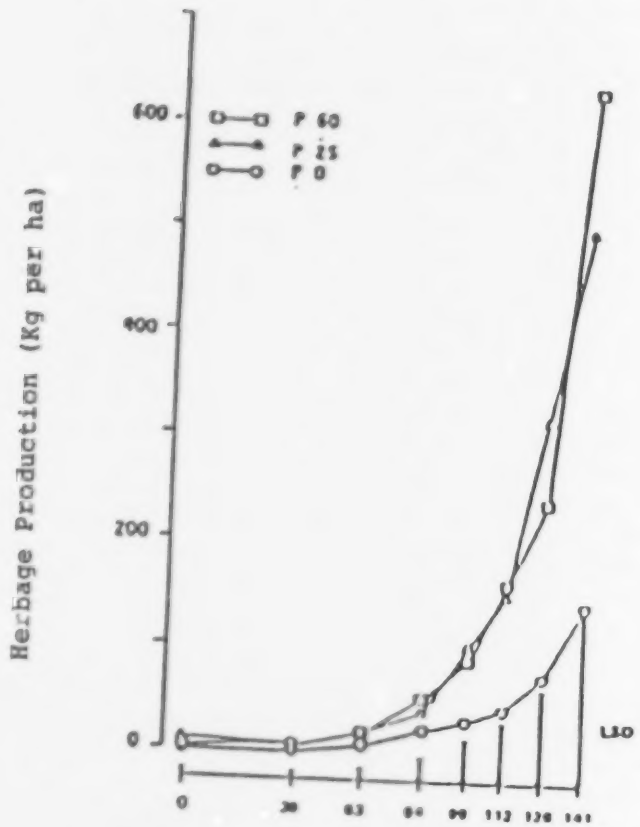


Figure 1. Available legume herbage (Kg per ha) in grazed native pasture on marginal land at Tel Hadya at three rates of phosphorus application. 0 (circles), 25 (triangles), and 60 (squares) Kg of $\frac{P}{2}\frac{0}{5}$ per ha (mean of two stocking rates). Bars represent L.S.D. at $P < 0.01$.

**TABLE 1**

Dry matter yield (kg per ha) of grass and other herbs in grazed marginal land pasture at Tel Hadya during year 3 as affected by phosphorus application.

| Species | Month | $P_o$ | $P_{25}$ | $P_{60}$ | LSD |
|---|---|---|---|---|---|
| GRASS | Dec 1 | 24 | 45 | 25 | 11.5[1] |
| | Jan 8 | 33 | 56 | 31 | 15.0[1] |
| | Feb 1 | 44 | 106 | 55 | 24.4[1] |
| | Feb 22 | 98 | 160 | 108 | 43.6[1] |
| | Mar 9 | 91 | 164 | 144 | 44.5[1] |
| | Mar 22 | 145 | 188 | 139 | 34.5[2] |
| | Apr 5 | 207 | 313 | 248 | 80.5[1] |
| | Apr 20 | 435 | 431 | 369 | n.s. |
| OTHERS | Dec 1 | 19 | 16 | 21 | n.s. |
| | Jan 8 | 37 | 44 | 50 | n.s. |
| | Feb 1 | 79 | 76 | 104 | 24.4[2] |
| | Feb 22 | 202 | 156 | 263 | 56.6[1] |
| | Mar 9 | 257 | 239 | 340 | 71.8[1] |
| | Mar 22 | 340 | 286 | 359 | 66.7[2] |
| | Apr 5 | 429 | 379 | 487 | 78.3[2] |
| | Apr 20 | 468 | 512 | 574 | n.s. |

[1] F-test and L.S.D.'s significant at $P<0.01$.
[2] F-test and L.S.D.'s significant at $P<0.05$.
n.s. F-test not significant.

**TABLE 2**

Effect of superphosphate on seed yield (kg per ha) and seed number (number per $m^2$) for legume species on marginal land.

| Fertilizer | Year 1 | | Year 2 | | Year 3 | |
|---|---|---|---|---|---|---|
| treatment | Seed Yield | Seed number | Seed yield | Seed number | Seed yield | Seed number |
| 0 | 28.6 | 2072 | 14.2 | 1596 | 21.0 | 2858 |
| 25 | 36.6 | 3114 | 22.2 | 2063 | 68.3 | 8786 |
| 60 | 46.1 | 3995 | 41.6 | 3379 | 99.0 | 11704 |
| LSD (P<0.05) | 11.7 | 825 | 10.5 | 751 | 22.0 | 2278 |

high SR showed lower plant densities than low SR, this differences becoming marked in year 3 (Table 3).

Sheep were introduced for grazing in July 1985, consequently, sheep recording took place. In year 3, sheep grazing fertilized pasture were heavier than the controls (Fig. 2a). Sheep at low SR(Fig. 2b)were always significantly heavier (P ranging from <0.05 to <0.001) than sheep at high SR. These patterns were almost identical to those in year 2.

TABLE 3

The population density (number of plants per $m^2$) and total dry matter yield (kg per ha) in marginal land pasture at Tel Hadya during year 3 as affected by two levels of stocking rate : low (0.8 sheep per ha) and high (1.7 sheep per ha).

| MONTH | DENSITY | | | DRY MATTER YIELD | | |
|---|---|---|---|---|---|---|
| | LOW SR | HIGH SR | LSD | LOW SR | HIGH SR | LSD |
| Dec 1 | 2705 | 1747 | 534[1] | 63 | 47 | 12.56[1] |
| Jan 8 | 3802 | 3022 | 771[1] | 100 | 77 | 17.99[1] |
| Feb 1 | 4941 | 3525 | 977[1] | 190 | 146 | 34.17[1] |
| Feb 22 | 6487 | 4863 | 1120[1] | 419 | 312 | 59.07[1] |
| Mar 9 | 5193 | 3882 | 705[1] | 540 | 432 | 71.67[1] |
| Mar 22 | 4499 | 3601 | 601[1] | 698 | 516 | 87.46[1] |
| Apr 5 | 3730 | 2821 | 517[1] | 971 | 824 | 109.37[1] |
| Apr 20 | 2676 | 2377 | n.s. | 1441 | 1269 | 142.98[2] |

[1] F-test significant at P<0.01 to 0.001 and L.S.D.'s are quoted for P<0.01.
[2] F-test and L.S.D.'s significant at P<0.05.
n.s. F-test not significant.

Lambs born at low SR grew faster than those at high SR (Table 4), but no differences due to rates of fertilizer were observed. The effect of phosphate application might become evident on lambs if the suckling period could have been extended to 12 weeks rather than 8 weeks.

Milk production per ewe was not significantly affected by phosphorus or stocking rate, showing only a general trend and confirming the results of year 2. This might be attributed to high genetic variation in milk yield of Awassi fat-tailed sheep. In fact the average milk yield per ewe in 1987/88 was 82 kg per lactation excluding suckling period, on the other hand individual ewe reached an average of 115 kg of milk per lactation.

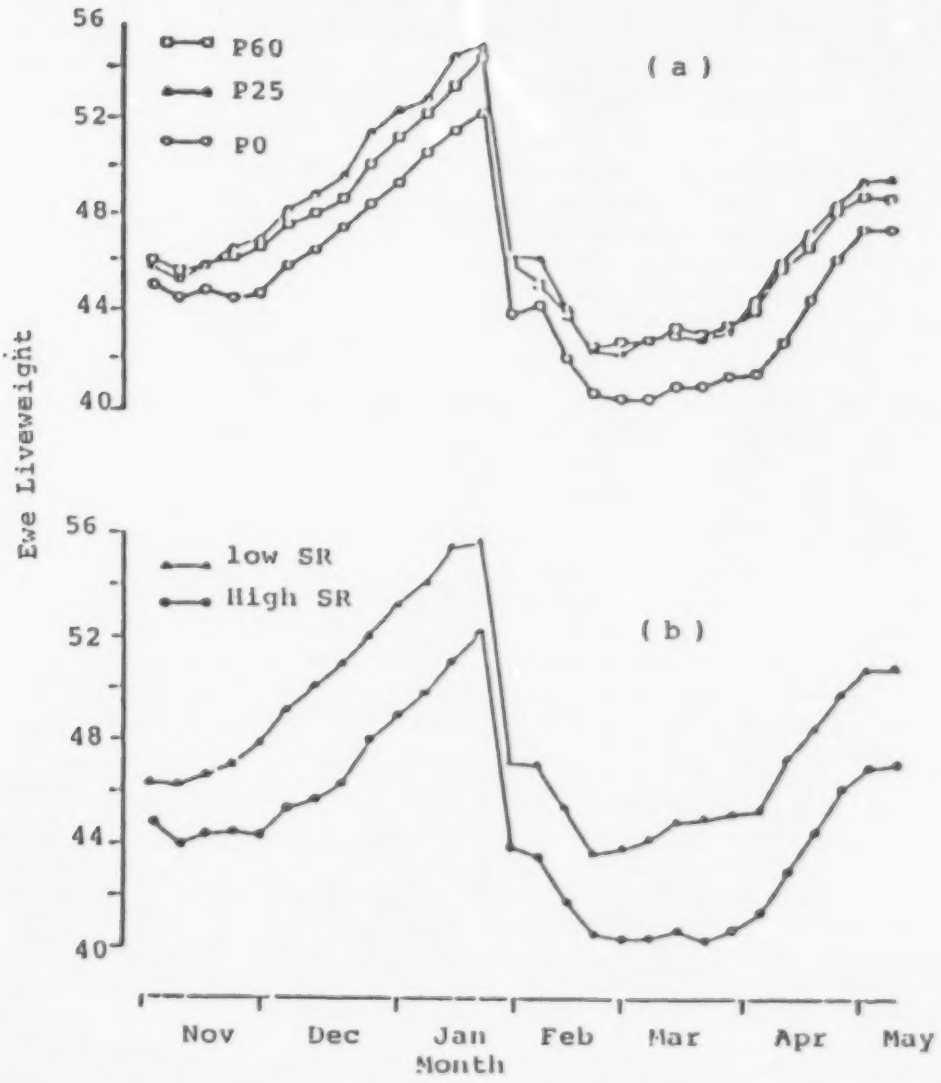


Figure 2. Ewe livewights between November 1986 and March 1987. the ewes grazing native pasture at(a) three rates of phosphate (mean of two stocking rates) and (b) two rates of stocking (mean of three phosphate rates).

**TABLE 4**

Lamb liveweight (kg) on weekly basis and changes under low and high stocking rate.

| Date | Low SR | High SR | LSD |
|---|---|---|---|
| Birth | 4.83 | 4.78 | n.s. |
| week 1 | 6.81 | 6.68 | n.s. |
| week 2 | 9.13 | 8.73 | n.s. |
| week 3 | 11.44 | 10.90 | 0.421[2] |
| week 4 | 13.76 | 13.01 | 0.659[1] |
| week 5 | 16.08 | 15.12 | 0.762[1] |
| week 6 | 18.39 | 17.24 | 0.872[1] |
| week 7 | 20.69 | 19.34 | 0.978[1] |
| week 8 | 23.01 | 21.45 | 1.092[1] |
| Growth rate (g per day) | 330 | 302 | 17 |

[1] F-test and L.S.D.'s significant at P<0.01.
[2] F-test and L.S.D.'s significant at P<0.05.
n.s. F-test not significant.

It was assumed that annual metabolizable energy (ME) needs of Awassi ewe yielding 110 kg milk was estimated at about 4200 (MJ) (Thomson, 1986). During lambing season, it was necessary to feed ewes grazing pasture when their liveweight fall bellow 45 kg. The $P_o$ treatment was fed more than those grazing at $P_{2s}$ and $P_{co}$, Table 5. Total annual supplement fed to sheep at $P_o$ treatment in year 4 was significantly more than those at fertilized treatments (845, 424 and 529 MJ per ewe), duration of supplementary feeding was longer at $P_o$ than those at $P_{2s}$ and $P_{co}$ (103, 64 and 57 days).

**TABLE 5**

Effect of phosphorus application on total annual feed consumption by sheep grazing pasture of marginal land in three years MJ/ewe.

| Fertilizer | 1985/86 | 1986/87 | 1987/88 |
|---|---|---|---|
| $P_o$ | 984 | 817 | 845 |
| $P_{2s}$ | 950 | 691 | 424 |
| $P_{co}$ | 838 | 771 | 529 |
| LSD (p<0.05) | 517 | 139 | 250 |

Similarly sheep grazing at high SR needed to be fed more than at low SR (Table 6). It was evident that sheep grazing at high SR in year 87/1988 received more feed than low SR (907 vs 380 MJ per ewe), thus the duration of supplement extended from 41 days for low SR and 108 days for those at high SR. Accordingly, pasture of different fertilizer treatment ($P_o$, $P_{25}$ and $P_{50}$) provided 80, 90 and 87% of the total annual ME needs of sheep, on the other hand pasture of high SR and low SR provided 78 and 91% of the total requirements.

**TABLE 6**

Effect of stocking rate on total annual feed consumption by sheep grazing pasture of marginal land in three years MJ / ewe.

| Stocking rate | 1985/86 | 1986/87 | 1987/88 |
|---|---|---|---|
| Low SR | 835 | 643 | 381 |
| High SR | 1013 | 875 | 907 |
| L.S.D. (P<0.05) | 546 | 84 | 243 |

**CONCLUSIONS**

Marginal lands of Syria have long been used as grazing lands, they play an important role in the economy of the livestock sector. They are misused by overgrazing and cultivation. The results of this trial which combine continuous grazing and phosphorus application showed that marginal land can be used more efficiently for raising livestock.

Applying triple super phosphate had corrected the phosphorus deficiency and increased legume species in the first year of the trial and produced more herbage and seed. This fertilizer is available commercially and required to be use every year to provide optimum phosphorus. Continuous grazing allows for greater seed set and hence greater number than traditional system. The legumes persist indefinitely, and the Rhizobia will keep on fixing nitrogen.

More available herbage increases ewe and lamb liveweight and decreases the need to feed during stress period by 75% and reduce the duration of supplement from four months to one month. It is expected that more revenues could be obtained by extending lactation period from 8 to 12 weeks; this will allow better use of the pasture at the peak stage of the plant growth in March and April.

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# METHODS OF EVALUATING PRODUCTIVITY OF NATIVE SHEEP UNDER BOTH RESEARCH FARM AND PRODUCERS CONDITIONS

E.S.E. GALAL[1] and A.A. YOUNIS[2]

1. Department of Animal production, Faculty of Agriculture, Shubra Al-Khaima, Cairo, Egypt.
2. Matarya, Cairo, Egypt.

## ABSTRACT

Different measuring criteria (indices) may be used to evaluate flocks and/or individual within flocks for certain objectives under certain conditions. Information on performance of the individual is important in experiment stations and stud flocks while information on the flocks is important in making comparisons between groups of animals species, production systems or countries. Units of the index may be biological, monetary or any other appropriate units. The paper discusses different production indices used in experimental and commercial flocks of sheep and their uses and limitations.

## INTRODUCTION

Measuring animal traits is the cornerstone of any monitoring or improvement program. Data on animals and environment are all important to understand physiological expression of the animal potential and to draw plans to increase efficiency of production. In the Near East region sheep flocks are of a small size and distributed over a wide range of environmental conditions. This invites a serious consideration for measuring the traits so that data my be legible.

This paper outlines the main objectives and methods of evaluating productivity of native sheep both under research farms and producers conditions. Different measures employed in the literature for assessing productivity of sheep are examined.

## OBJECTIVES OF EVALUATION

Objectives of evaluating productivity differ between research farms and producers conditions. Under commercial

farm conditions sheep growers would be interested in profitability as such and production may be expressed in terms of output per unit of input. Production may be expressed per unit of animal, land or labor and this depends on their relative importance. In other words they would be interested in economic rather than biological efficiency. Accordingly, sheep breeders would be concerned about total income and total cost. In order to improve sheep and goat production it is important to make quantitative assessments of present biological and economic productivity (Peacock, 1987). The highest producing flock is not necessarily the most economic one, i.e. the biological productivity may not coincide with the economic productivity (Bedier et al., 1988).

In commercial flocks sheep breeders would be interested as well in identifying deficiencies in the production processes so as to be able to correct them and increase productivity. It is realized that causes behind low productivity may differ among different flocks. For example, low conception joined with low twinning rate may be responsible for low productivity in a certain flock, while slow growth and high mortality rate in lambs would be behind low productivity in another flock. Approaches for correcting these deficiencies would differ among both flocks.

In experimental flocks objectives of evaluating productivity may include:

- Description of the performance of a certain breed under a certain set up of environment.
- Studying the adaptability of different breeds and crosses under different environments.
- Testing the effect of a certain managerial procedure or treatment on different aspects of production.
- Measuring different parameters for genetic improvement.
- Identifying reasons behind low productivity and maximizing production efficiency.

## NATURE OF DATA COLLECTED

In commercial flocks and in most instances data have to be collected on the flock as a whole and not on individual basis as it is the case with experimental ones. Obtaining data on individual animals is quite costly apart from the fact that it is not necessary under most circumstances in commercial flocks. Individual records may only be necessary if the flock is used for producing stud rams.

Data collected from commercial flocks would include:

- Number of lambs marketed.
- Average weight of lambs at marketing.
- Weight of produced milk and wool.
- Size of the flock and animal weights in different classes.
- The value of different products (Lambs, milk and wool).
- The cost of different inputs (labor, feed, capital cost, ...etc.).

In experimental flocks data collected may include:

- Live body weight at different ages (birth, weaning, yearling, ...etc.).
- Productive and reproductive performance.
- Pedigree.
- Physiological parameters.
- Feed and water intake.
- Meat, milk and wool characteristics.
- Metrological and environmental effects.

**EVALUATED TRAITS**

Under commercial conditions productivity may be evaluated using the following parameters:

- Percentage of ewes lambing.
- Number of lambs born.
- Number of lambs weaned.
- Number of lambs marketed.
- Mortality rate of lambs (from birth to weaning and from weaning to marketing).
- Number of kilograms lambs marketed per ewe present in the flock.

The latter measure may be considered as one of the most indicative parameters for measuring efficiency of production in the flock. If the flock is mainly kept for milk or wool as its prime product then data will be collected mainly on the amount of milk and grease fleece yield produced.

In experimental flocks data are collected on individual basis as previously mentioned and traits related to productivity may be classified to reproductive and productive ones. The first group may include oestrus duration, average number of services per conception, conception rate, average litter size and lambing interval. Productive traits would include lamb, milk and wool produced per ewe present in the flock. If productivity is to be presented by one single figure then other products than lamb production may be transformed to lamb units.

## METHODS OF EVALUATING DIFFERENT TRAITS

Lamb/meat production is a function of ewe fertility, prolificacy and mothering ability, lamb mortality and lamb weight. On research farms where all these traits can be measured a conclusive index of lamb production is the average number of kilograms weaned per ewe joining the ram. This may also be measured at marketing to account for possible post-weaning dam effect. This measure may be used for selection purposes as well as for comparing different flocks and it can be expressed per mating (e.g., yearly or every 8 mo), for a fixed period of time or for the ewe life time, thus, it can account for lambing interval. To make such measure relevant to the feed requirements of the flock it may be calculated as kilograms weaned per kg ewe joined or unit of metabolic ewe size i.e. ewe weight $^{0.75}$. Lamb production may also be expensed in terms of kg carcass marketed on any other form of output, e.g. edible meat. If, however, fertility is a main target of measuring, that may be evaluated by number of lambs (born, weaned on surviving to certain age) per ewe joined. These two callgoues, i.e. weights and numbers for measuring experimental flock lamb production are used quite extensively in the literature.

Ewes and rams sold from the flock may be incorporated in this measure to calculate total biomass or its meat equivalent produced out from the flock. To account for flock dynamics and different policies of marketing and keeping rams meat production may be measured per weight of the flock. While this has been suggested by Peacock (1987) in commercial flocks it was not encountered in the literature in experimental flocks.

In commercial flocks where individual identification and detailed animal record-keeping are not practical only average values of traits composing lamb production and fertility may be used. Indexer thus calculated are useful for managing the flocks and comparing them. The following indices have been reported:

1 - Flock meat productivity (FMP) = litter/year x young/litter x weaning viability x average weaning wt., Peters (1987)
2 - Flock efficiency (FE) = FMP/female wt$^{0.75}$, Peters (1987). In case the ewe is also used for milk Peters (1987) gave the following two indices:
3 - Flock performance productivity (FPP)

= FMP+({ daily milked-out yield} x { days of lactation}) / 9

4 - and flock performance efficiency (FPE) = FPP/ewe $wt^{0.75}$. Sow et al. (1987) used a different index to express kg weaned per ewe joined (Pr),

5 - $Pr = F [(2-P) V_1 W_1 + 2(P-1) V_2 W_2]$, where F is fertility, P is prolificacy, $V_1$ and $V_2$ are viability of single and twin lambs, respectively, and $W_1$ and $W_2$ are weight at 90 d of single and twin lambs, respectively. While Peters (1987) indices take into account lambing frequency, that of Sow et al (1987) does not. Fitzugh and Bradford (1983) used an index to study the productivity of hair sheep of Western Africa and the Americas. Their flock productivity index was.

6 - FP1 = litter size x offspring viability x birth wt / Parturition interval

This index does not take into account the proportion of females actually parturition of the total potential breed.

Wilson (1983) and Wilson et al (1985) used the indices

7 - Index I = Total live weight of litter at 150 d x 365 / Subsequent parturition intervals d

8 - Index II = Index I / Post partum wt. of dam to base lamb out put-per kg of ewe, and

9 - Index III = Index I / Post-partum wt of $dam^{0.73}$

To make lamb output relevant to feed requirement of the ewe. A shortcoming in indices I, II and III is that they are based on ewes parturition, making no account of nonconceiving ewes.

Peacock (1987) developed an index for comparing the performance of Maasai flocks in Kenya at producing young and rearing them to weaning and to reproduction age (18 mo) per year. The index was

$$10\text{- Weaning \& 18 mo. Index} = \frac{\text{No. of parturit.} \times \text{Litter size} \times \text{Survival (wean.} \text{ \& 18 mo)} \times \text{wt (wean.) \& 18 mo}}{\text{Mean flock weight}}$$

This index accounts for parturition rate by including in the denominator all potential breeder ewes. This index is the only one among all reported above that takes into account the negative effect of keeping old rams and castrates past their optimum selling age on the economics of

the flock by including their weight in the denominator. Peacock (1987) also developed another index to assess the overall flock production in "terms of sales, consumption, social uses and increase/decrease in flock size per unit of flock". Unit of the index may be number of animals, weight on monetary.

$$\text{Flock Production Index} = \frac{\text{Sales} + \text{Slaughter} + \text{Social transaction out of flock} + \text{New inventory change}}{\text{Initial flock size}}$$

**Milk production.**

A clear distinction must be made between measuring milk production for animals kept for dairy production and of yield of milk available for suckling lambs in non dairy sheep. Both sheep differ in their let-down characteristics. Practically two methods of assessing milk production the choice of one on another depends on the resources available and the objective of measurement (Peart, 1982).

a. Lamb suckling. In sheep the estimation has been most commonly made over 24 h period, weekly for 4-6 fixed time intervals over the test period. Sometime the 24 h period is reduced to 12 h with little loss in accuracy

b. Hand-or machine-milking
The serious shortcoming of this method is that most non-dairy sheep breeds require the stimuli associated with lamb suckling for continued production and release of full milk potential.

These two methods can be applied in both experimental and commercial farms.

**Wool**

To producers, the most important single measure of wool is the greasy fleece weight. If no individual identification was available then an easy measure of flock wool production would be average greasy flock weight obtained by

Total weight of wool shorn in one year/ No of animals shorn

Mid-side wool samples from a sample of sheep may be taken for estimation of clean yield, fiber diameter (especially in fine wool breeds) and fiber length. Other detailed

characteristics may be obtained on individual and bulky samples in experimental flocks as the need be. Other easy-to-measure characteristics are odd colors, body wrinkles and face openness.

**Sample size**

Sample size in survey data must be appropriately determined in order to estimate flock performance and differences between flocks with a certain degree of accuracy at determined error types I & II probabilities. In field records variability in performance traits is usually high, coefficient of variation reaching 30% in growth traits and 35% in fertility trails (Peters, 1987). Table 1 (after Peters, 1987) shows sample size in a one-tail test.

However, this topic is discussed in most of the references from purely statistical point of view which renders many estimates for sample size too impractical for field conditions. More work on sample size and sampling technique is required.

TABLE 1

Sample size in comparative breed evaluation: Number of replications required for a given probability of obtaining a significant result[1].

| True difference as % of mean | Coefficient of variation | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 6 | 8 | 10 | 12 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| 5 | 9 | 19 | 33 | 50 | 72 | 112 | 198 | 310 | 446 | 607 | 792 | 1002 | 1238 |
| | 12 | 26 | 45 | 69 | 69 | 99 | 155 | 429 | 617 | 840 | 1097 | 1388 | 1714 |
| 10 | 3 | 6 | 9 | 13 | 19 | 29 | 50 | 78 | 112 | 152 | 198 | 251 | 310 |
| | 4 | 7 | 12 | 18 | 26 | 40 | 69 | 108 | 155 | 210 | 275 | 347 | 429 |
| 15 | 2 | 3 | 5 | 7 | 9 | 13 | 23 | 35 | 50 | 68 | 88 | 112 | 138 |
| | 3 | 4 | 6 | 9 | 12 | 18 | 32 | 49 | 69 | 94 | 122 | 155 | 191 |
| 20 | 2 | 2 | 3 | 4 | 6 | 8 | 13 | 20 | 29 | 39 | 50 | 64 | 78 |
| | 2 | 3 | 4 | 5 | 7 | 11 | 18 | 28 | 40 | 54 | 69 | 87 | 108 |
| 25 | 2 | 2 | 2 | 3 | 4 | 6 | 9 | 13 | 19 | 25 | 33 | 41 | 50 |
| | 2 | 2 | 3 | 4 | 5 | 7 | 12 | 18 | 26 | 35 | 45 | 57 | 69 |
| 30 | 2 | 2 | 2 | 3 | 3 | 4 | 7 | 10 | 13 | 18 | 23 | 29 | 35 |
| | 2 | 2 | 3 | 3 | 4 | 5 | 9 | 13 | 18 | 24 | 32 | 40 | 49 |

[1]Upper figure: test of significance at the 5% level, probability 80% one-tailed tests.
Lower figure: test of significance at the 5% level, probability 90% one-tailed tests.

## CONCLUSIONS

The many production measuring criteria used in measuring sheep productivity reflect the fact that no one standard index can be used under all circumstances. In each situation an appropriate index should be used or developed to meet the objective of that index and the result obtained using such index should be interpreted bearing in mind the limitations of the index. However, in making comparisons between flocks, breeds, systems of production or countries some standardization is required. Peacock (1987) stated five characteristics a production index must have if it is to be useful, an output component, an input component, a clear specification of the time period (most commonly one year), "units relevant to the subject and a description of the context under which the results were obtained and to which the results are to be applied". The difference in a standard index applied to both an experiment station and commercial flocks may indicate the magnitude of "yield gap" (Kinpscheer et al., 1987) for potential improvement.

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# SOME ECONOMIC ASPECTS AFFECTING SMALL RUMINANTS DEVELOPMENT IN NEAR EAST COUNTRIES

I. SOLIMAN

Department of Agriculture Economics, Faculty of Agriculture,
Zagazig University, Zagazig, Egypt.

## INTRODUCTION

Sheep have many advantages over other livestock and are, particularly, well adapted to many regions, (Singh, 1969 and Singh, and Moore, 1978). Sheep produce more than one kind of products each year, milk, wool and lambs, bringing the flock owner an income more than once a year. Since the crops are entirely different (have different markets), the price of one will not necessarily have a bearing on the other. Wool may be stored and held for higher prices or sold at shearing time, whichever seems advisable. A crop of lambs may be marketed from 5-6 months after they are born, bringing in rather quick return or to be kept for older age (one year or older). Sheep have the ability to produce prime carcasses on roughages alone, they are especially well adapted to many areas unable to produce crops profitably.

Sheep eat varied kinds of feeds or plants than other livestocks, these make them special class of livestock that can wastes to profits for the farmers.

Sheep do not require expensive buildings and equipment. In cold weather, only worm housing at lambing time, and a dry place to lie down are needed. Natural protection furnished by hills or trees is all that many range flocks have.

## DEMAND FOR SHEEP AND GOATS MEAT

The demand at the producer level is derived from the demand at the consumer level. Therefore, the share of small ruminants (SR) in the meat market and farm output is determined by the size of the demand for such type of meat.

The consumer's preference and taste are the major structural variables that determine the demand for SR meat. It seems that a comparative analysis of the demand for SR

meat among Arab countries is a representive case study.

On the average mutton and goat, the meat represent about 59% of the total red meat consumption in Arab countries (table 1). However, in five countries such type of meat represents more than 70% of the total red meat consumption. In 11 countries this type of meat represents between 40% to 60% of the total red meat consumption. Only, in three countries SR meat is of minor importance. These countries are Iraq (36%), Morocco (30%) and Egypt (17%).

TABLE 1

Per capita gross domestic product and red meat consumption in Arab Countries *

| Country | Per capita gross domestic product ($) | Per capita consumption : Beef (kg) | Sheep & goats (kg) | Total red meat (kg) | (%) of SR of total red meat |
|---|---|---|---|---|---|
| Jordan | 1642 | 3.4 | 9.3 | 12.70 | 73.1 |
| Syria | 2051 | 3.5 | 13.0 | 16.51 | 78.8 |
| Iraq | 3117 | 6.8 | 3.9 | 10.71 | 36.5 |
| Lebanon | 1281 | 8.9 | 8.5 | 17.42 | 49.0 |
| Yemen Dem. | 478 | 1.8 | 2.6 | 4.44 | 58.9 |
| U.A. Emirates | 22952 | 6.8 | 7.5 | 14.32 | 52.3 |
| Bahrin | 12923 | 14.1 | 10.5 | 24.67 | 42.7 |
| S. Arabia | 13005 | 8.4 | 20.6 | 28.92 | 71.1 |
| Qatar | 8115 | 3.8 | 32.5 | 36.26 | 89.6 |
| Kuwait | 12764 | 17.1 | 26.9 | 44.00 | 61.1 |
| Tunisia | 1180 | 5.2 | 4.8 | 10.02 | 48.0 |
| Algeria | 390 | 3.9 | 5.5 | 9.43 | 58.8 |
| Libya | 7234 | 6.3 | 9.7 | 16.02 | 60.4 |
| Egypt | 678 | 8.2 | 1.7 | 9.89 | 16.8 |
| Morocco | 632 | 4.9 | 4.1 | 8.95 | 45.7 |
| Djibouti | 1633 | 6.6 | 8.9 | 15.50 | 57.3 |
| Sudan | 314 | 14.0 | 5.9 | 14.94 | 29.8 |
| Somalia | 336 | 9.1 | 11.5 | 20.55 | 56.0 |
| Mauritania | 462 | 3.6 | 8.8 | 12.35 | 70.9 |

* Source : Arab Organization for Agricultural Development, (1985).

Therefore, SR meat has the first periority with respect to the consumer's preference in most Arab countries. The consumer preference for SR meat (mainly mutton and lambs

meat) limits, significantly, the income-response with respect to the red meat demand. The income-demand relationship (Engle's Curve) for SR meat in the Middle East (Arab countries) showed a highly significant positive response (equation 1.), while this relation was not significant with respect to beef consumption (equation 2.)

$$Ln\ (QMUTT) = -0.1706 + 0.2970^{**}\ Ln\ (CPTGDP) \quad .....[1]$$

with, $R^2 = 0.3230$ and $F = 8.1^{**}$ (significant at $p < .01$)

$$Ln\ (QBEEF) = 0.8500 + 0.1283\ Ln\ (CPTGDP) \quad .....[2]$$

with, $R^2 = 0.1028$ and $F = 1.9^{n.s}$ (non significant at $p < .05$)

Where, (QMUTN) is the annual consumption per capita of SR meat in kilograms, CPTGDP is the annual per capita and QBEEF is the annual per capita consumption of beef in kilograms. The data used is a cross-section data of the year 1983 (Arab Organization for Agricultural Development, 1985).

From equation 1, the estimated income elasticity for SR meat is 0.297, i.e. an increase in per capita income by 10% is associated with an expansion in SR meat by approximately 3.0 kg. The expected annual population growth of the area, estimated from the statistics published by Arab Organization for Agricultural Development (1985), is around 3.2%. These considerations might suggest that the Middle East SR meat market is, eventually, likely to expand most rapidly, except in three countries. However, these three countries (Egypt, Morocco and Iraq) have about 44.8% of the Arab countries population.

## PRODUCTION AND CONSUMPTION OF SMALL RUMINANTS MEAT IN EGYPT

### CONSUMPTION PATTERN & DEMAND FOR RED MEAT

Meat consumption, demand and production of sheep and goats in Egypt are investigated in the following sections. Table 2. shows the red meat consumption pattern in Egypt in 1986, as a target country of the present workshop. The per capita consumption of total red meat was 9.9 kg, of which only 15% was SR meat. Beef was the major proportion, i.e. more than 55%.

Given the nature of meat production and Egypt's limited supply flexibilities in the short term, time-series analysis was used to estimate the reduction of the normal demand from different red-meat types (Shapouri and Soliman, 1985). From these models the income-elasticity for red-meat types was

estimated (table 2) and compared with the estimates of other countries.

From table 2, 10% growth in the per capita real income in Egypt will raise the demand for SR meat by 4% , while it will raise the demand for beef by 13.5% and veal by 7.8%. Only, aged (culled) cattle and buffalo cows meat and imported frozen meat have less income-demand response than SR meat in Egypt. This result shows that the economic growth in Egypt will raise the demand for cattle and buffalo meat at much higher rate than sheep and goat meat. Sheep and goat meat consumption has a distinguished seasonal pattern. The males are consumed mostly during religious occasions.

TABLE 2

Red meat consumption pattern in Egypt.

| Type of Red Meat | Capita Consumption kg / year[1] | % of Total | Estimated average income demand elasticity coefficient[2] |
|---|---|---|---|
| Total Red Meat | 9.9 | 100 | 0.91[a] |
| Buffalo-Veal | 0.6 | 6.1 | 0.78[a] |
| Beef | 5.5 | 55.5 | 1.35[a] |
| Sheep & Goats | 1.5 | 15.1 | 0.40[a] |
| Aged Cattle & Buffalo | 1.0 | 10.1 | 0.08[a] |
| Imported Live Animals | 0.6 | 6.1 | ---- |
| Imported Frozen Meat | 0.7 | 7.1 | .10[b] |

1) from : Organization of Veterinary Services, Ministry of Agriculture official Slaughter hours data , present of off-slaughter hours animals were added.

2) Shapouri and Soliman, (1958). and Soliman, (1983).

It seems that a sociological behaviour in the national community limits the demand for SR meat. In United Kingdom, USA, Italy and France, the income-demand elasticity for mutton and lambs is higher than Egypt, i.e. 0.45 (Oxford University, 1975), 0.6 (Butz and Baker, 1960), 0.5 (FAO, 1962) and 0.6 (FAO, 1962), respectively. In German Fedral Republic, Belgium and the Netherlands, the income demand elasticity is less than Egypt, i.e. 0.24, .17, and 0.24, respectively (FAO, 1962).

**Small Ruminant Production on Egyptian Farm**

The study of Soliman and Ragab (1982) showed that the income generated from sheep and goats holding per feddan decreases, gradually as the farm size increases. It decreases from about L.E. 36 on the farm of less than one feddan to L.E. 2 on the farm larger than 10 feddans (table 3). They showed also that the relative share of the sheep and goats in the total livestock income per feddan decreases from about 4.2% on the smallest farm size to approximately, 9% on the farm size class 3 to 5 feddans. Above 5 feddans, the importance of the income from the sheep and goats has very little share in the farm income.

Soliman and Nawar (1986), investigated the patterns for livestock on the Egyptian farm using an extensive sample survey. They found that the average herd size per farm is 5.28 sheep animal units, of which females represent 4.2% and males represent 3.4%.

TABLE 3

Contribution of sheep and goats in livestock income per feddan by farm size class in 1982.

| Farm size class | Income from sheep and goats | | Total livestock income (l.E.) |
|---|---|---|---|
| | value (L.E.) | % of total livestock income | |
| Less than 1 Feddan | 35.7 | 4.2 | 848 |
| 1-3 Feddans | 20.3 | 4.8 | 422 |
| 3-5 Feddans | 25.2 | 8.9 | 282 |
| 5-10 Feddans | 5.5 | 2.6 | 210 |
| Above 10 Feddans | 1.3 | 1.5 | 83 |

Source ; Soliman and Ragab (1982).

Female goat represent 4.6% and male goat represent 2% of the total herd per farm. Therefore, sheep and goats on the farm represent, on the average, about 7.6% and 6.6%, respectively, of the total livestock holdings. Accordingly, sheep and goats have little importance on the conventional Egyptian farm either in investment pattern or income pattern of livestock.

**SMALL RUMINANTS SUPPLY UNDER RAIN-FED AGRICULTURAL PATTERN IN NEAR EAST**

Sheep and goat production under rain-fed agriculture in

Near East, is a type of production under extensive, risky and uncertain conditions. The total agricultural area of the Arab countries (22 countries) is 130,963 thousand hectares, of which only less than 30% is cultivated. Seventy-three percent of the cultivated area rain fed is agriculture. In addition to that, there are 265969 thousand hectares range land (Arab Organization for Agricultural Economics, 1983). Most of the range land is under very low and fluctuating rain fall, i.e. less than 200 $mm^3$. Under rain fed agriculture, production is highly, unstable. The instability in grain production of the Arab countries is very high. Among 15 concerned countries, the instability coefficient for grain production was above 40% in 13 countries, i.e. after the omission of the time trend, there are more than 40% deviations above or below the annual production of grains in Arab countries (Arab Organization for Agricultural Development, 1983).

Sheep and goat supply is highly affected by such unstable feed supply. Soliman and Rountree (1986) compared the time series analysis of meat supply versus feed grain supply among three representive Arab countries (Syria, Egypt and Morocco). They found that the higher the rate of instability in feed grain supply, the higher the instability in meat supply and meat price. It seems that sheep are drastically affected by poor years and drought. In poor years the percent of the herd died is very high. In Morocco, 40 % of the sheep flocks were lost due to successive frequent drought periods occurring over the last 15 years (Arab Organization for Agricultural Development, 1983). In poor years, the off-take rate for slaughter increases. Therefore, the supply in the market raises and the price decreases. Even if some poor years are followed by good years, the herd size and structure can not be rebuilt to reach its original level.

In a recent report by the National Council for Research in Sudan (1988), sheep are raised in very low rain fall areas. Over grazing is a common feature because sheep flocks unlike cattle and camels are not able to travel for vast distance. Therefore, they are left with very little chance for survival during drought.

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"Working Paper for Round Table 1"

# IMPLEMENTATION OF INTENSIVE LAMB PRODUCTION SYSTEM IN THE NEAR EAST REGION

A. M. ABOUL-NAGA

Animal Production Research Institute, Ministry of Agriculture, Dokki, Cairo, Egypt.

Intensive lamb production in the dry-subtropical NE can be recommended only under the following conditions:

* Availability of feed resources; forages and locally produced concentrates.

* High demand and good market for the produced lambs (early fattened).

* Reasonable level of hygienic conditions.

Elasaticity of different production elements for intensive lamb production under the dry-subtropical NE conditions can be summarized as follow :

a) **Accelerated lambing** Implementation of two crops a year / ewe is usually accompanied with hormonal treatment and artificial rearing of the lambs. The first is usually expensive and may need skilled breeder, while the second need high level of hygienic measurements, or it will result in high lamb losses, and expensive milk replacers. Producing crop each 7-9 months have the advantage of using no hormonal treatment and natural suckling is applied for lambs rearing lambs and first of all, it needs relatively unexpensive hygienic precautions.

b) **High prolificacy**, high litter size (over 2 lambs) can hardly be provided by the native sheep, unless high proportion of prolific temperate genes is introduced. Such high level of lamb production need, unlikely, artificial rearing of the lambs with some of uncontrolable measures under the prevailing subtropical conditions. High lamb losses in such high litter size is usually expected.
Moderate litter size (1.5 - 2 lambs) can be produced by

the prolific dry-subtropical genotype, their first cross with native sheep or by the introduction of low percent of temperate prolific genes, (Finn, Romanov), all showed some success in the region.

c) **Low lamb losses**, native subtropical sheep and their crosses are usually well adapted to the prevailing conditions and of low lamb losses. On the other hand, temperate breeds are less adapted, especially the highly prolific ones and can not be recommended under arid-subtropical condition.
Artificial rearing and high litter size (over 2) is another cause of high lamb losses and should be avoided.

d) **Fast growing lambs**: native sheep breeds are generally not fast growing animals. Creep feeding and early fatting on whole concentrate diet, are reported to give good results with some native breeds. Crossing with other native subtropical breeds, as a sort of stratification system, or with temperate breeds which proved to be adapted to the region, could produce fast growing lambs.

e) **Early fattening**: Generally late fattening is followed in most of the NE countries due to customes devolves and or religious traditions. Socio-economic aspects of this points need more understanding as it is an important element in the implementation of intensive lamb production in the NE.

f) **Ewe feeding**: With the low body size of native ewes, their maintenance requirement is generally low. Supplementary feeding is required: 2 weeks before mating, during the last 2-4 weeks of pregnancy and the first 2 weeks of lactation. Also,a balanced mineral supplement during lactation is needed.

* Output from an applicable intensive lamb production under NE condition can be as follows:

kg marketed/ewe/year = 0.8-0.9 (conception rate)
* 1.4-1.6 (crop/year)
* 1.5-2.0 (litter size)
* 0.85-0.90 (lamb vitality)
* 25-30 kg (weight at 4 months of age)
~ 55 kgs annually (vs. 15-20 kgs under the prevailing systems).

" Working Paper for Round Table 2"

# PLANNING REQUIREMENTS FOR EXECUTING SMALL RUMINANTS DEVELOPMENT PROGRAMMES

A. W. QURESHI

FAO, Rome

## INTRODUCTION

The 26 countries of the Near East region, listed in Table 1, raise some 24 percent of the world's goats and 20 percent of its sheep. A large segment of the small ruminant population is raised under extensive conditions in desert ranges and marginal lands. Intensified production is dominant in countries such as Cyprus and Egypt and fattening operations in Syria and Gulf countries contribute considerably to the meat supply. In most of these countries, sheep and goats contribute a major part to the total red meat production and a large part of rural milk production. However, the small ruminants share in herbivore production is declining in many countries, due to current emphasis on cattle production (Table 1).

The recent upsurge in demand for red meat, spurred by increased income and rapid urbanization is largely satisfied through imports. This has also stimulated indigenous production. Intensified commercial production at various scales has started in many countries. The major problems in sustaining and expanding such operations are of technical nature. The producers and prospective investors do not know of alternate production systems suited to the various situations of pasture, feed supply and market conditions. There is not sufficient input-output data available to devise such systems.

Development of profitable livestock production enterprises requires the establishment of efficient support services for disease control, feed supply and marketing. A technically feasible production system will not be sustained without this development support. The small ruminant research and development programmes must handle all these requirements simultaneously.

TABLE 1

Small ruminants population and the share of its production (%) in the total milk meat produced by herbivores.

| | Sheep (000 h) | | Goats (000 h) | | Meat % | | Milk % | |
|---|---|---|---|---|---|---|---|---|
| | 1976 | 1986 | 1976 | 1986 | 1976 | 1986 | 1976 | 1986 |
| Afghanistan | 21 200 | 20 000 | 3 000 | 3 000 | 65 | 66 | 25 | 27 |
| Algeria | 9 337 | 14 795 | 2 142 | 3 090 | 52 | 65 | 34 | 38 |
| Bahrain | 3 | 7 | 13 | 15 | -- | -- | -- | -- |
| Cyprus | 225 | 325 | 210 | 225 | 21 | 21 | 63 | 37 |
| Egypt | 1 878 | 1 149 | 1 349 | 1 583 | 12 | 13 | .9 | .8 |
| Djibouti | 370 | 410 | 510 | 500 | 76 | 62 | -- | -- |
| Iran | 33 500 | 34 500 | 14 000 | 13 600 | 55 | 58 | 24 | 21 |
| Iraq | 10 000 | 8 981 | 3 300 | 1 475 | 55 | 31 | 31 | 31 |
| Jordan | 565 | 930 | 381 | 439 | 76 | 93 | 69 | 60 |
| Kuwait | 125 | 227 | 90 | 325 | -- | 31 | 46 | 38 |
| Lebanon | 150 | 137 | 200 | 460 | -- | -- | 27 | 35 |
| Libya | 4 434 | 5 550 | 1 857 | 950 | 75 | 48 | 42 | 46 |
| Mauritania | 4 200 | 3 950 | 2 430 | 3 000 | 36 | 31 | 54 | 52 |
| Morocco | 14 270 | 14 545 | 5 750 | 5 276 | 38 | 31 | 6 | 5 |
| Oman | 57 | 213 | 165 | 700 | 45 | 33 | 31 | 71 |
| Pakistan | 18 937 | 25 826 | 21 693 | 30 785 | 40 | 44 | 3 | 3 |
| Qatar | 38 | 118 | 41 | 68 | 60 | -- | 38 | 30 |
| Saudi Arabia | 2 243 | 3 800 | 1 577 | 2 350 | 55 | 51 | 34 | 27 |
| Somalia | 9 800 | 11 800 | 15 700 | 18 800 | 36 | 39 | 49 | 47 |
| Sudan | 14 494 | 18 950 | 11 254 | 13 900 | 30 | 26 | 32 | 35 |
| Syria | 6 490 | 11 669 | 956 | 1 006 | 77 | 76 | 10 | 7 |
| Tunisia | 5 978 | 5 800 | 1 052 | 1 100 | 50 | 52 | 12 | 6 |
| Turkey | 41 336 | 40 400 | 18 763 | 13 100 | 65 | 62 | 21 | 22 |
| United Arab Emirates | 75 | 382 | 198 | 778 | 22 | -- | 35 | 42 |
| Yemen Arab Republic | 1 799 | 2 553 | 1 661 | 1 660 | 79 | 78 | 57 | 43 |
| People's Democratic Republic of Yemen | 855 | 930 | 1 145 | 1 380 | 76 | 67 | 57 | 57 |

Source: FAO Agrostat data

This paper provides a rationale for these programmes, identifies the technical and institutional constraints and describes the research and development requirements from the planning point of view.

## RATIONALE FOR SMALL RUMINANT DEVELOPMENT

### Potential for Greater Resource Utilization

The livestock pressure on agricultural land (arable land and permanent pastures) varies widely in different Near East countries. Egypt, for example, has no pastures or rainfed lands and livestock pressure amounts to 1.4 large ruminants and 0.95 small ruminants per hectare of irrigated land which is mostly devoted to food and fibre crops (Qureshi, 1985). On the other hand, Mauritania and Somalia raise their ruminant stock on dry rangelands and the livestock pressure per hectare in Somalia is more than five times that in Mauritania.

Except for parts northern Iraq, Yemeni highlands, eastern Mediterranean and coastal strips in northern Tunisia, Algeria and Morocco, all Near East lands fall within arid zones. Vast tracts suffer from a length of plant growing period of less than 75 days and are classified as arid. These lands are not suitable for rainfed crops except for planting browse shrubs and for permanent pastures.

Annual fodder crops in rotation with food and fibre crops or with perennial grasses and legumes constitute basic feed resources for livestock in arable areas. In recent years the exploitation of ground water has also increased considerably in some countries. This has greatly increased the opportunities for intensified commercial production of milk and meat. However, the irrigated areas are now plagued with problems of water-logging, salinity and deterioration of the quality of both surface and ground water. Furthermore, the intensive use of fertilizers and pesticides is increasingly polluting the water resources. These are the problems needing continuous monitoring and control. Furthermore, livestock production will have a secondary claim on the irrigated lands and lands in high rainfall areas.

In spite of the harsh climate, degraded rangelands, the hardy pastorales and the adapted livestock of the region offer large opportunities to increase meat production. Small ruminants are particularly adapted to the prevailing harsh climate. The Awassi, Nejdi, Barbary and Blackhead Somate sheep are excellent examples of adaptation to desert range conditions. With small improvements in feeding and management, they respond greatly with reproductive output and growth.

The vast tracts of arid rangelands and managerial grazing can only be utilized by the indigenous sheep and goats. The substantial sheep and goat population in the region

subsisting on the meagre forage is a valuable resource, and there are large possibilities of improving their productivity mainly by expanding the feed supply in a sedentary or semi-sedentary system. Small ruminants are useful in this respect as they can digest low-quality fibrous roughage and are particularly suited to the requirements of rural producers. Goats occupy an important place in utilizing the shrubs and coarse vegetation of the arid lands. Where almost barren and uncultivable land is the main source of feed and where family labour is available, the goat is the most beneficial animal to be reared.

**Socio-economic considerations**

Sheep and goat meat is the favoured food of animal origin in the region. Its demand has increased rapidly with increased income. The price of fresh meat has also increased markedly. The meat : feed ratio has become highly favourable. Thus, an attractive opportunity has opened up for indigenous production. Investors are eager to finance meat production and marketing enterprises. However, efficient and sustainable patterns of production have yet to be established.

Sheep and goat raising is an important economic activity in rural areas. It provides year-round employment and absorbs surplus family labour which has very small opportunity cost. Investment requirements are not high from rural standards and the mortality risk is low because of low cost per animal. Increasing the offtake per breeding female increases the net income considerably. The expansion of rural small ruminant flocks and intensification of production has been proved to result in increased rural family income. There is a need to establish efficient patterns of rural small scale production and to support it with the required veterinary and extension services as well as with credit facilities. Small ruminants development projects in many countries are aimed at fulfilling this need.

**CONSTRAINTS AND OPPORTUNITIES**

**Technical**

The major objective of livestock development in most developing countries is to intensify production by applying improved technology, in order to increase production from existing systems. This objective may also include devising new production systems based on new technology. An objective that crops up more and more these days is the conservation of land and animal resources. However, this may not

necessarily conflict with the objective of maximizing resource use.

To achieve the above objective, an array of known technologies are usually identified implementation - often in planning sessions. The felt needs of the producers are rarely taken into account. Sometimes the methodology of systems approach in identifying and implementing a technical solution is not known.

Attempts to characterize farming systems, especially the studies conducted by ICARDA (Bahhady, 1987), have demonstrated the variety of problems and potentials of small ruminant production systems in the region. These systems include both the traditional low input/ low offtake systems and those utilizing additional inputs of feed resources and technology to increase yields of meat and milk. ILCA experience with such studies also illustrates their complexity and multi-disciplinary nature. Yet, it is necessary to understand the existing production systems and to clearly identify the relative importance of major technical and economic constraints. Otherwise, there could be a danger of devoting disproportionate research and development efforts to pursue certain technologies that appear interesting from the scientific point of view or are appealing to the administrators.

In the Near East, the increasing demand for red meat has generated a drive to increase small ruminant production from rangelands, from rainfed and irrigated land and from feedlots which are often based on imported feedstuffs. This has also attracted investment at various scales. Further investment is being constrained by the fact that the outputs envisaged are not forthcoming. Technology packages and management systems specific to particular situations appear to be missing or incomplete. Appropriate technology packages incorporating the management of health, feeding and breeding of the flocks need to be developed for each production system.

It is now recognized in many countries that the economic climate is favourable to the establishment of intensified production systems based on improving grazing, supplementary feeding and feedlot fattening. However, technological innovations in the present state of art are needed to :

- expand the feed base within the land and water resources available in the rangelands and the arable areas;
- efficiently utilize the imported feedstuffs;
- increase the reproductive output of a flock;
- improve the genetic potential in relation to improved

feeding regime and management system;
- develop management packages to ensure flock health; and
- improve the processing and marketing of products, especially milk.

**Institutional**

The problems encountered in the application of technological possibilities are mainly organization. The institutional structures usually determine the effectiveness of the disease control, production management advice, input supply, marketing and credit support to the producer. The main institutional deficiency appears to be in providing effective disease control at small holder level and in providing technical support to the producer which results in increased production and profits.

Major difficulties in improving the effectiveness of technical institutions may be listed as follows :

- The educational institutions, both at professional and middle-level, do not adequately emphasize practical training. Whatever the social conditioning of the trainees, a strong practical routine should prepare them for manual work required for livestock production and disease control.
- The extension personnel are often hampered by lack of mobility to reach the producer and by a clear-cut technical programme to extend. The non-staff expenditure of extension and disease control services is in many cases alarmingly disproportionate.
- The capacity to plan and monitor small ruminants development in the livestock departments is limited-mainly due to the lack of trained staff assigned to this task.
- Essential linkage or integration of research and extension services at the farm level are often missing; thus constraining the implementation of a meaningful on-farm research-extension programme.

**REQUIREMENTS**

**Research Requirements**

The establishment of appropriate institutional structures is the primary requirement for undertaking development-oriented animal production research. The animal production research groups are found in the universities, agriculture research centers, veterinary departments and sometimes organized in a separate animal production research center. Whatever the institutional structure, the research group

should be able to :

- plan its activities in accordance with the needs of the producer and consumer;
- work in collaboration with all the groups concerned with animal production and health in the country as well as with agronomic research groups; and
- implement the research programme in cooperation with the farmer.

To start with, it is necessary to first characterize the existing production systems in the country and then to determine the various items of research that are necessary to improve this system. For the sake of present discussion, the following distinct systems involving sheep and goats may be briefly mentioned :

- Extensive sheep and goat production in the range and the marginal lands. Various attempts have been made recently to describe this system and its inter-relationship with cereal cropping. Improving rangelands is the central issue in increasing animal productivity from these areas.

- Mixed farming systems in higher rainfall areas incorporating intensive sheep and goat production. The complementarities of animal and crop production in these systems have been often mentioned. but there appears to be a need to generate systemic data to describe the production as well as the economic aspects of this relationship. There appears to be large opportunities for introducing better fodder production and animal husbandry techniques in the higher rainfall areas.

- Specialized production systems such as dairy goats and sheep feedlots. Major challenges in improving these systems are to find more adaptable management procedures, especially to reduce dependence on imported inputs.

While identifying the research needs of each of these systems, it is important to consider the possible cost-benefit of various innovations envisaged. Such a pre-testing analysis is usually necessary since most problems in improving a production system are site-specific, have known solutions and call for verification trials rather than experiments to generate new knowledge. Experience in developing countries has shown that trials and demonstrations on producer holdings yield larger benefits than those from research efforts at experiment stations directed towards generating new technologies.

The 1986 FAO Technical Consultation of the Near East Regional Cooperative Research and Development Network on Small Ruminants (FAO, 1987) identified four priority areas of research and recommended the respective collaborative research projects for the participating institutions. These areas of research are described below. It is pointed out that these priority areas were identified from the viewpoint of generating the required data for extension work and for investment follow-up.

**Research Project 1. Improving the reproductive output of indigenous sheep and goats**

The potentially valuable indigenous genetic resources must be adequately evaluated. This evaluation should be under the environmental conditions most likely to apply in the flocks and herds of producers. Exotic genotypes and crosses of exotic and indigenous breeds should be compared contemporarily with indigenous types in the same environments to determine which best fits the producer's needs. The level of nutrition should always be specified when reproductive traits of different genotypes are described.

Traits and procedures for this evaluation process should be standardized. A minimal standard set of traits should be identified. This minimal set should be practical for collection across sites but sufficiently comprehensive to indicate genetic differences in productivity. The reproduction complex of traits may include sexual maturity, length of breeding session, interval between parturitions, litter size born and weaned, etc. These traits are relatively simple to observe and indicate both fitness and productivity potential. The importance of reproduction was further illustrated by results from experiments with D'Man and Chios-regional breeds noted for high prolificacy. These breeds have particular potential for increasing meat yields from more intensive systems. However, the caution was raised that high levels of prolificacy are rarely appropriate to extensive, range-based systems.

The following priority areas of research were identified under this project :

- Seasonality of local breeds of sheep and goats either male or female and the way of utilizing their potentiality as non-seasonal breeds (identification of appropriate mating seasons on yearly or eight-monthly mating cycles).
- Evaluation of genetic potential of high-fertility local breeds of sheep and goats which could be of benefit to

the region.

- Investigating constraints in the reproductive output of local sheep and goats with emphasis on their mothering ability.

- Genetic improvement for fertility :
  a) selection for fertility in the promising local breeds;
  b) crossbreeding with regional breeds (Chios and D'Man) and temperate breeds (Finn and Romanov). Evaluation of adaptation of exotic breeds and crossbreeds.

Management practices to improve the reproductive output of local sheep and goats :

a) on-farm trials are recommended to validate the results of experiment station research on each topic before they are widely applied;
b) standardization of methodologies for evaluating reproductive function on the farms is also needed.

**Research Project 2. Strategic feeding and nutrition of small ruminants**

It is necessary to determine the nutrient supply from the various forage and feed resources as well as their seasonal availability in order to design strategic feeding systems and, where necessary, to adjust the breeding cycle to the cycles of seasonal nutrient availability. Various attempts at inventorizing feedstuffs in the Near East have indicated that a variety of feedstuffs are currently underutilized especially those that are non-conventional. These feeds are crop residues, agro-industrial and slaughterhouse by-products and feeds from animal origin. All of these have their potentials and shortcomings. The fibrous feeds can be improved in nutritive value by supplementation and by chemical treatments especially urea. Among the animal excreta, poultry litter offers a valuable protein source, which is of particular advantage when used in silage production using agro/industrial by-products such as citrus, olive or grape residues.

The objective of devising strategies for feeding should be to increase per animal productivity from utilizing available feed resources. Research in this direction should involve feeding trials incorporating various feedstuffs in balanced rations. Emphasis should be placed on making use of the potentially more valuable feeds which can be combined to form balanced diets. The usefulness of NPN, minerals and vitamins in supplementary feeding should also be determined.

The following priority areas were identified :

- The feed resource base should be studied thoroughly and be extended to include the utilization of underutilized feeds, especially non-conventional feeds.
- Assessment should be made of the types of feeds produced, their value in quantitive and qualitative terms, intake, digestibility, nutritive value, acceptability and inherent limitations, for example, toxic factors.
- Strategic supplementation was particularly important for the prevailing extensive, semi-intensive and intensive systems of production, this could be energy, protein, minerals or vitamins or combinations of these. The appropriateness of supplementation needs to be identified with the product (meat, milk or fibre).
- That feeding strategies and improved feeding systems should be tested especially on-farm to demonstrate value and cost effectiveness.

**Research Project 3.** Improvement of goat milk production

Meat is the principal product from sheep and goats in the region, but the value of dairy products and fibre is also substantial. In the region, sheep and goats generally serve dual, often triple purposes. However, the considerable value of milk and fibre from small ruminants remains unrealized because of poorly organized and inefficient collection, processing and marketing of these products. Milk yield is an important trait in subsistence production but in commercial production for cheese total solids yield (fat + protein) is an important consideration.

The use of dual-purpose Damascus or Shami goat for up-grading the Baladi types should be considered in arid areas. For commercial milk production crossbreeding with high-yielding European breeds may be undertaken.

The following items for research were specified :

- Evaluation of milk production potential of local breeds and evaluation of crossbreeding programmes. Estimation of milk production immediately after birth should be included in data collection.
- In commercial dairy goat herds, the effectiveness of early weaning should be determined. The cost-effective animal health management systems should be devised for these herds.
- Management packages for small herds including those for tethered goats should be identified and tested on farmer's holdings.
- Early weaning and fattening of kids as means of increasing milk and meat production.

**Research Project 4. Studies on small ruminants production within farming systems**

Small ruminants have a major role in balanced agricultural systems, especially for small-scale farmers. Thus, priorities for research and development to improve small ruminants should be set in the context of the inputs to the overall system. This systems approach involves the principal steps : characterization of the system including resource inputs, product outputs, operational processes and interactions; analysis of systems to identify constraints and practical options for their resolution; design and evaluation of interventions to existing systems; and implementation of technically, economically and socially feasible interventions by producers.

The items for research and development may include provision of adequate nutrients throughout the year, development of low-cost herd health management, productivity of indigenous genotypes, development of market infrastructure, analysis to support policy development to promote sheep and goat production and provision of credit assistance to producers. Computer models of sheep and goats used to stimulate alternative production systems may also be used to identify the technical as well as economic importance of technical interventions envisaged. Priority items are as follows :

- Whenever possible, proposals should be prepared to conduct simplified studies on small ruminant production systems from the viewpoint of identifying research needs of economic importance.
- Interested institutions should liaise with international research centers to plan and carry out these studies and technical assistance should be sought whenever needed.
- On-farm trials should form the integral part of research on the items specified for Research Projects 1,2 and 3.

**Development Requirements**

Effective linkage of research, extension and training is the most important requisite for developing and introducing improved technologies which the producer can use. In order to utilize the results of empirical research for small ruminants development it is necessary to harmonize market forces, incentives, policy making and research with training and human development of the producer. The process of generating research results must be effectively linked with other developmental elements. The producer must be involved in identifying research problems as well as in the verification of promising research results generated at experiment stations. Furthermore, research stations should

be fully involved in the process of technology transfer.

Improving and expanding sheep and goat production in rural areas requires local organizational base to channel the required services and credit. This has proved to be the most difficult aspect of the development process. Yet, there are some success stories of small-scale sheep and goat farm development in the region, e.g. the rural sheep development programme in Egypt (Aboul-Naga in FAO, 1987), the sheep and dairy goat project in Cyprus (Economides, 1987), the range and sheep cooperatives in Syria (Draz, 1983), dairy goat project in Tunisia (Mahjoub, 1987), and the goat farm development in Oman (Qureshi, 1988).

Various attempts have been made to establish an organizational structure that would ensure the provision of all the required inputs and services to the smallholder. In Syria, a National Feed Revolving Fund controlled by a Committee headed by the Minister provides credit for feed and farm development in coordination with the Ministry and the General Feed Organization. Omani goat farm development project is a good example where a whole array of organizations provide funds or technical support through the Project Supervising Committee. In the Tunisian dairy goat development project all the required inputs and services are integrated under one direction. In Egypt and Cyprus, the research institutes appear to be spearheading the development programmes. The experiences of these five countries are valuable in designing future programmes.

**International Cooperation**

Technical cooperation among developing countries (TCDC) is a widely accepted principle and a useful and expeditious mechanism to bring about a desired technological change in production systems common to a group of countries. Support for TCDC has been voiced in many FAO meetings and conferences involving Near East countries. However, the identification of specific problems in accordance with the felt needs of the countries and inadequate support for the coordination mechanism have been the major factors that have impeded the proliferation of TCDC activities on animal production in the region.

The Network approach being followed by FAO is designed to foster international technical cooperation. Actually, networks are a follow-up of traditional assistance provided by FAO, adapted to a new regional reality, characterized by a smaller flow of external resources and a greater availability of national knowledge and experiences which may be exchanged among the countries of the region. In October

1984 a "Regional Expert Consultation on Small Ruminants Research and Development in the Near East" was held in Tunis to discuss the relevant research and development activities in Member Countries and to identify current priorities in the Region for the various activities required to establish appropriate production systems involving sheep and goats. The Expert Consultation recommended the establishment of a "Regional Cooperative Research and Development Network on Small Ruminants". The First Session of the Near East Commission on Agriculture, held in Cairo in March 1984, endorsed the recommendations of the Expert Consultation and the Eighteenth FAO Regional Conference for the Near East, held in Istanbul in March 1986, urged Member Countries to participate in the Network through appropriate national research and development institutions.

The First Technical Consultation of the Network was held in Rome in October 1986. It was attended by the Network focal-point scientists nominated by the Governments of Cyprus, Egypt, Iraq, Pakistan and Tunisia. Other participants included three scientists from European Sheep Network; observes from ILCA, IDRC, USA and F.R. Germany and FAO staff members.

The technical Consultation discussed work plans to participate in the Network as proposed by the designated institutions in the interested countries. The research plans are expected to be systems-oriented and aimed at generating data required for the purpose of extension and investment follow-up. TCDC-styled arrangements were discussed to operate the Network largely through national manpower, institutional and financial resources. The collaborative research work to be carried out through the Network was also discussed together with other cooperative activities of the Network including training courses, study tours, publications and biennial technical meetings.

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## RECOMMENDATIONS

I. **Research** :

The following research areas should be given high priority :

1. Feeding, management of young lambs / kids and developing lamb / kid appropriate rearing systems.

2. Comparative evaluation of efficiencies of single-purpose vs. dual-purpose breeds / systems.

3. Use of concentrates, including grains, for intensive breeding / fattening and fattening operations.

4. Potentials of manipulating forage and stubble feeding.

5. The four projects recommended by the Near East Research Network as discussed in the working paper of Round table II of the workshop :

   a) Improving the reproductive output of indigenous sheep and goat (APRI, Egypt as the Regional Liaison Center).
   b) Strategic feeding and nutrition of small ruminants
   c) Improvement of goat milk production
   d) Studies on small ruminants production within farming systems

6. Standardization of research techniques. Appropriate protocols and procedures should be comparable and communicable from one institution to another.

2. **Development** :

1. Measurement of efficiency of a production system in a way to make the output related to the total flock rather than the individual animals economic animals economic input / output should also be considered.

2. Developing selection procedures including the screening of large population in order to establish elite flocks and herds for growth, milk yield, prolificacy and fibres.

3. Developing procedures to characterize an existing production system in order to identify constraints and possibilities.

4. A due consideration should be given to the flow of regional germplasm among countries in the Near East in order to improve productive traits especially for breeds recognized as distinct in some aspect of production, e.g. Awassi, Chios and D'man sheep and Damascus goats.

5. Close collaboration among the various research training and extension agencies in the country is essential for meaningful implementation of required research and development programmes. Effective mechanisms for this collaboration should be established in the form of joint activities and task forces for each programme.

6. More information is needed to understand socio-economic factors involved in SR production and consumption.

**3. Extension :**

The farmer is the crucial and indispensable element in improving the existing production system or developing new production systems. Following the systems approach, the farmer should be involved at all stages of research and development i.e. in planning as well as in the implementation of research, on-farm testing and demonstration. The needs, objectives and capabilities of the target group of farmers should be fully considered while defining improved production systems.

Extension should be directed towards the whole family emphasizing the importance of women and children in the SR operation.

## LIST OF PARTICIPANTS

| Name | Address | Country |
|---|---|---|
| M. Aboul-Ela* | Dept. of Anim. Prod.<br>Faculty of Agric.<br>El-Mansoura Univ.<br>Tel : 852151 | Egypt |
| A.M. Aboul-Naga* | Anim. Prod. Res. Inst.,<br>Minstry of Agriculture.<br>Dokki Cairo Tel: 704820/856174<br>Telex 22032 FCRI<br>Fax 202/ 722 609 | Egypt |
| H. Almahdy | Anim. Prod. Res. Inst.,<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel: 704820 | Egypt |
| G. Ashmawy | College of Agriculture,<br>Cairo University, Giza<br>Tel. : 2600289 | Egypt |
| A.F. Bahhady* | ICARDA office, SYRIA,<br>P.O. Box 5466 Aleppo<br>Tel. : 223477,<br>Telex 331263 ICARDA SY | Syria |
| J. Boyazoglu* | Secretary General (EAAP)<br>Corso Trieste, 67<br>00198 Rome-Italy<br>Telex : 613440 AIAI<br>Tel. 39/6/8840785 | Italy |
| P. Chemineau* | Station de Physiologie<br>de la reproductin, Institut<br>National de la Reserche<br>Agronomique, 37380 Nouzilly,<br>Telex: INRATOU 750954, F<br>Tel : 47427905 | France |
| A. Constantinou* | Agric. Res. Inst.,<br>Research Institute,<br>Cyprus, Nicosia,<br>Telex: 4660 MINAGRI CY<br>Tel : 2-352551 | Cyprus |

| | | |
|---|---|---|
| C. Devendra* | Programme Officer,<br>IDRC, Tanglin, P.O.Box 101,<br>Singapore 9124<br>Telex 53-3753, Tel.: 2351344 | Singapore |
| A. Eddebarh | Institute Agronomique et<br>Veterinaire Hassan II,<br>B.P. 6202 Rabat.<br>Tel. 71758, 71759<br>Telex : Agrouet 3178 M. | Morocco |
| Eglal Rashid* | IDRC office, Cairo<br>El-Hesny st. No. 4 Giza<br>Tel. :047322215 | Canada |
| F. El-Keraby | Animal Production Resrearch<br>Station, Sakha, Kafr El-Sheikh<br>Tel. : 047322215 | Egypt |
| H. El-Oksh | Dept. of Anim. Prod.,<br>Faculty of Agric. El-Azhar Univ.<br>Nasr City, Cairo. | Egypt |
| A. El-Serafy* | Dept. of Anim. Prod.,<br>Faculty of Agric.,<br>Ain. Shams Univ.,<br>Shoubra El-Kheima, Cairo.<br>Tel: 2591608 | Egypt |
| A. El-Sherbiny* | Dept. of Anim. Prod.,<br>Faculty of Agric.,<br>El-Azhar Univ.,<br>Nasr City, Cairo. | Egypt |
| M. El-Shobokshy* | Dept. of Animal Prod.,<br>Facu. of Agric., Zagazig Univ.,<br>Zagazig. | Egypt |
| S. El-Zoghbi | American Univ. Cairo.<br>Tel: 3555322 | Egypt |
| M. Fahmy* | Canada Agriculture<br>1650 Provnce,<br>Sherbrooke, QUE.<br>Tel.: 819-567-2317 | Canada |
| M. Farid | Dept. of Anim. Prod.,<br>Desert Research Inst.<br>El-Mattaria.<br>Tel.: 2435519 | Egypt |

| | | |
|---|---|---|
| Ferial Hassan* | Anim. Prod. Res. Ins.<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel: 704820 | Egypt |
| J.C. Flamant* | Unite de Reserches Sur<br>Les Systemes Agraires<br>et le Developpment B.P. 27<br>F- 31326 CASTANE - TOLOSAN,<br>Tel.: 61.28.52.60<br>Telex: 520009 F | France |
| M. Gabr | Anim. Prod. Res. Station,<br>Sakha, Kafr El-Sheikh | Egypt |
| E.S.E. Galal* | Dept. of Anim. Prod.,<br>Faculty of Agric., Ain Shams<br>Univ., Shoubra El-Kheima,<br>Cairo.<br>Tel: 2464408 | Egypt |
| C. Gall* | Institute for Animal<br>Production in the tropics and<br>subtropics, Univ. of Hohenheim<br>480, 7000 Stuttgart<br>Telex 722959 UNIHO, D | GDR |
| J. Galvez | Escuela Tecnica Superior De<br>Ingenieros Agronomos,<br>28040 Madrid.<br>Tel. 244487 | Spain |
| Y. Ghanem | Desert Research Institute<br>El-Mattaria, Cairo.<br>Tel. : 3602301 | Egypt |
| R. Guirguis* | Desert Research Inst.<br>El-Mattaria, Cairo. | Egypt |
| G. A. Guada | Catedra de Alimentecion,<br>Faculfad de Veterinaria<br>University de Zaragoza.,<br>Migue Servet-177,<br>50013-Zaragosa.<br>Tel.: 976-413388<br>Telex 58198 | Spain |
| F. Guessous* | L'Institut Agromonique et<br>Veterinaire Hassan II<br>Boit Postale 6202 Rabat. | Morocco |

| | | |
|---|---|---|
| O. Guney | Faculty of Agriculture, Dept., of Anim. Sci., University of Çukurova Adana.<br>Tel.: 0090/71/133391<br>Telex : 62934 | Turkey |
| M. Hadjipanayiotou* | Agriculture Research Institute Ministry of Agriculture and Natural Resources Nicossia.<br>Tel.: 30-3431,<br>Telex MINAGRI 4660 CY | Cyprus |
| F.W. Haenlein* | College of Agriculture<br>University of Delware<br>048 Townsend Hall<br>Newark, DE 19717 - 1303 | USA |
| J.P. Hanrahan* | The Agricultural Institute<br>Tuam,Co. Galway,<br>Tel : (093) 24619 | Ireland |
| M.K. Hathout | Anim. Prod. Res. Inst.,<br>Minstry of Agric., Dokki, Cairo<br>Tel: 702934 | Egypt |
| I. Hatziminaoglou | University of Thessaloniki<br>Analipseos 16 55236<br>Thessaloniki.<br>Tel. : 941975 | Greece |
| A. Heider | Anim. Prod. Res. Ins.,<br>Ministry of Agric.,<br>Dokki, Cairo. | Egypt |
| M. Jousset | Mission de Recherche et Ceeperation<br>Tel. : 103641-717856, Cairo<br>Telex : 93088 CEFEC UN | France |
| C. Kayouli | Dept. des Sciences des Prod. Anim. INAT, 43 AV. Charles Nicolle, 1002, Tunis.<br>Tel.: 01/280-046 | Tunisia |
| G. Khaldi* | Departement Zootechine,<br>INRAT, Avenue de l'Independence,<br>Ariana, Tel: 230107 | Tunisia |
| F. Kishk* | IDRC, Cairo<br>Tel. : 738760, Telex : 92520 | Egypt |

| | | |
|---|---|---|
| A. Lahlou-Kassi* | Dept. of Reproduction<br>Agric. and Veterinary Inst.,<br>Hassan II, Agdal, Rabat,<br>Tel : 513-72 | Morocco |
| H. Mansour | Dept. of Anim. Prod.<br>Faculty of Agric., Ain Shams<br>Univ., Shoubra El-Kheimah,<br>Cairo. | Egypt |
| H. Metawi | Anim. Prod. Res. Inst.<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel: 704820 | Egypt |
| P. Morand-Fehr* | Station de Nutrition et<br>Agronomique, Institute National<br>Agronomique, 16 rue Claude-Bernard,<br>75231 Paris CEDEX 05, France | France |
| M.R. Mousa | El-Serw Research Station,<br>Anim. Prod. Res. Inst.,<br>Demiat. | Egypt |
| S. Nakhla | Anim. Prod. Res. Inst.,<br>Ministry of Agric.,<br>Dokki, Cairo. | Egypt |
| A.W. Qureshi* | Near East Regional Office<br>Anim. Prod. & Health Division,<br>FAO, 00100 Rome.<br>Tel.: 57974105,<br>Telex 610181, FAO. | Italy |
| G. Ricordeau* | Institute National de<br>Researche Agronomique,<br>Station D, Amelioration Genetique<br>Des Animaux, Auzeville,<br>P.O.27, 31326<br>Castanent-tolosan.<br>Telex: INRASE-520009 | France |
| Y. Salah* | FAO Representative, Cairo<br>Tel. : 705182 | Egypt |
| O. Salama | Anim. Prod. Res. Inst.,<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel: 704820 | Egypt |

| | | |
|---|---|---|
| M.M. Shafie* | Dept. of Animal Prod.,<br>Faculty of Agric.,<br>Cairo Univ., Giza.<br>Tel: 852959 | Egypt |
| T. Shalaby | Anim. Prod. Res. Inst.,<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel 704820 | Egypt |
| M. Sharafeldin* | Ministry of Agriculture<br>Consultant, Ministry of<br>Agriculture, Dokki, Cairo. | Egypt |
| E. Shehata | Anim. Prod. Res. Inst.,<br>Ministry of Agric.,<br>Dokki, Cairo.<br>Tel: 704820 | Egypt |
| I. Soliman* | Dept. of Agricultural<br>Economics, Fac. of Agriculture,<br>Zagazig Univ., Zagazig | Egypt |
| C. Spedding* | Dept. of Agricultural,<br>Univ. of Reading, Early gate,<br>Reading, RG6 2AT, UK<br>Telex 847813 | UK |
| F. Swidan | Dept of Anim. Prod.<br>College of Agric., Suez Canal<br>Univ., Ismailia.<br>Tel. : 2470786 | Egypt |
| J. Tisserand | Ecole Nationale superieure<br>des Sciences Agronomiques<br>Appliiquees 26 Bd Dr. Petitjean.<br>21100, DIJON. | France |
| J. Tops | School of Agriculture<br>Aberdeen Univ.<br>581 King Street, Aberdeen<br>Tel. 0224 480291,<br>Telex 75838 | UK |
| A. Vaz Portugal | Ministry of Education-INIA<br>Lespone,<br>Tel. : 043-76282 | Portugal |
| A. Younis* | Desert Research Inst.<br>El-Mattaria, Cairo.<br>Tel. 2471682 | Egypt |

N. P. Zervas*

Laboratory of Anim. Prod.
Faculty of Agric., Aristotle
Univ. of the Thessaloniki
Box 257 G. 54006 Thessaloniki

Greece

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* Invited speakers, chairmen and organizers.